INSECT PESTS OF THE HOUSEHOLD

OHIO
Agricultural Experiment Station

WOOSTER, OHIO, U. S. A., DECEMBER, 1912.

BULLETIN 253

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BULLETIN
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Ohio Agricultural Experiment Station

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INSECT PESTS OF THE HOUSEHOLD

By R. D. WHITMARSH

INTRODUCTION

Household insects today attract wide attention. It has become known in recent years that some among them are transmitters of disease, and, therefore, are dangerous to mankind. Besides these inimical forms, some of which are more or less familiar visitors in every household, one has to contend with a variety of other household insects under many and varied conditions. It is hoped that this bulletin will aid those looking for information regarding some intruder new to them, and assist them in exterminating the pest, if it be such; also, that it may relieve the unpleasant fears which careful housekeepers sometimes entertain at the appearance of some really insignificant insect, but which they suspect to be a calamitous visitation, not to be mentioned outside the family circle.

THE TYPHOID FLY

(*Musca domestica* Linn.)

One of the most common and most widely distributed of household pests is the common house or typhoid fly. This insect, which has been given but little consideration until recently, now attracts wide attention. It is known to carry typhoid fever, tuberculosis, cholera, cholera infantum and dysentery, and it is possible that it may also carry smallpox, leprosy, plague, erysipelas, and other dangerous diseases.

The fly, unlike the Anopheles mosquito, is merely a conveyor of disease, rather than an incubator for it. The germs of malaria are of a protozoan type and can exist only in man and the intermediate

host—the mosquito. On the other hand, typhoid germs (*Bacillus typhosus*) are bacterial and are to be found outside the human body in both urine and excrement; therefore, they are readily picked up by the feet, mouths and hairs of flies, and transported to foodstuffs, exposed groceries, and all sorts of accessible eatables. The fly has fleshy mouth-parts and, consequently, is unable to bite and in this way inoculate men or animals with disease, although many people have credited it with the power to do this. It is frequently mistaken for the closely related biting house fly (*Stomoxys calcitrans*) which is of similar size and appearance and provided with piercing mouth-parts which enable it to bite.

It is a well known fact that house flies are to be found feeding voraciously upon excrement, sputum, and all kinds of accessible filth. Also, if the opportunity is afforded to one of them, it may next feed upon foodstuffs, either in grocery, market, or on the table, leaving in its wake a trail of sickness and death.

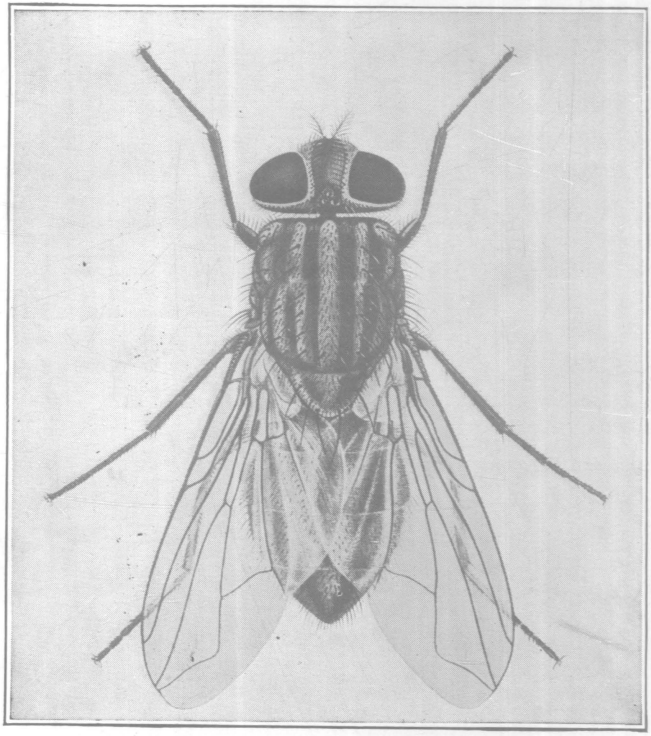


Fig. 1. Typhoid Fly.

The typhoid fly was so named quite recently by Dr. L. O. Howard, because of the overwhelming evidence that it is largely responsible for the spread of the bacterial germs of typhoid fever.

It has been estimated that 250,000 Americans have this disease each year, 35,000 of the cases proving fatal. It is a well established fact that the germs of typhoid occur in the intestines, and that the excreta from a person, both before and after the symptoms of the disease are detected, may contain them in sufficient numbers to spread disease through an entire neighborhood. This is especially true in country districts having open privies, in army camps, etc., where the excreta is deposited in the open. Under such conditions, flies find it easy to feed for a time and then, laden with the deadly disease germs, take wing and alight on the food of man.

Certain conditions which exist in some sections of our cities and towns, are reprehensible, and persons responsible for such conditions should be compelled by law to keep their localities sanitary. The full page illustration at the end of the bulletin shows some of the conditions which exist in an Ohio city; moreover, this is not the only example, nor by any means the worst to be found in the state. The picture, I think, speaks for itself, suggesting that such situations should be given attention by the proper city authorities, thereby removing the danger so plainly threatened. This scene is merely used as one that is representative of restricted localities in many cities in Ohio and elsewhere, and not with the idea that the city pictured is any worse in this respect than other towns.

One can never tell just when disease will break out in a neighborhood, and, through the agency of flies, which breed in an accumulation of filth, be spread amongst its residents. It is certainly not pleasant, at least for persons who realize the danger confronting them, to sit down to a meal and see flies crawling about on the table. No one knows where they came from nor what kind of germs are adhering to their bodies, though a single microbe, if of a noxious kind, may cause disease. Another objection to living in such neglected localities is that there are almost invariably myriads of flies flying about on warm days, these delighting to swarm about persons sitting out of doors, at times making the place unbearable.

The fly is by no means the only purveyor of intestinal diseases, but it seems very probable that during the warm months, at least, it is their main carrier. Milk is a great medium for the spread of bacteria, it being well known that various germs multiply in it very rapidly. One can readily see the results, then, if one of these flies, laden with myriads of bacilli, should fall into the milk. This very

often happens and sometimes one hears people correctly laying an epidemic of typhoid to the milk obtained from a certain milk man. Therefore, avoid all milk dealers who do not use strictly sanitary methods in the handling of their milk.

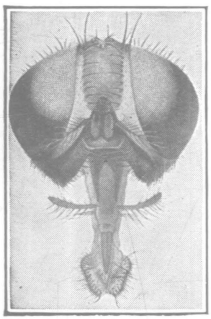


Fig. 2. Head and mouth parts of typhoid fly.

Water may also be a carrier of typhoid germs but this is usually of recent contamination, as the bacteria in a flowing stream live but a short time, usually not reproducing. However, soil may be contaminated, and by means of water, rain, etc., the germs may be carried along into wells and cisterns, the water from which is used for household purposes. By this constant renewal of infection, water may be kept contaminated for a great length of time.

As a general rule, it can be stated that flies do not travel more than two or three hundred yards away from their breeding places. Bacteria have been known to live within the bodies of flies for three weeks or more. Consequently, one can readily see that the same fly may distribute germs many times and in many places without revisiting the source from which it first obtained its deadly supply.

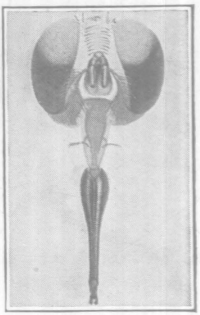


Fig. 3. Head and mouth parts of biting house fly.

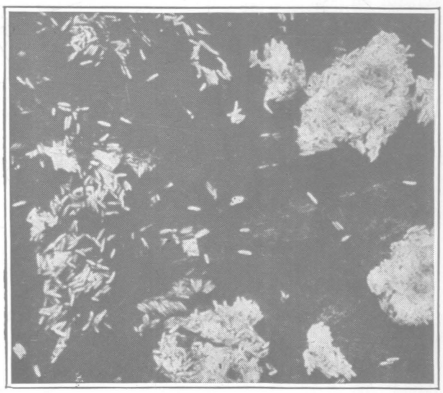


Fig. 4. Eggs of Housefly.

LIFE HISTORY

The housefly breeds in horse manure, by preference, but will deposit its eggs in human excrement, in spittoons, and in decaying vegetable matter of various kinds. It has been estimated that in cities and towns where garbage is taken care of properly, 95 percent of the house flies come from horse manure.

The housefly belongs to a group of insects having a complete metamorphosis, that is, it has four stages of very different appearance, namely, the egg, larva (maggot), pupa (resting stage) and imago (adult fly). In this respect it differs from the cockroach, the grasshopper, and many other insects which transform gradually from the larva to the adult, the different stages of these quite resembling each other throughout the whole series of changes.

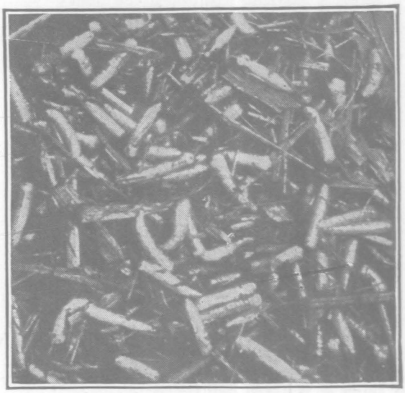


Fig. 5. Larvae in horse manure.

The fly is of solitary habit when laying her eggs and deposits them in groups of a hundred, more or less, and is capable of producing several such layings. The eggs hatch in less than 24 hours, the incubation period depending upon the temperature.

The next stage, the larval (maggot), lasts about a week, and the third or pupal (resting stage) extends over about the same time. These periods may be shortened or lengthened, depending upon the temperature. Therefore, under average conditions, we may obtain the adult fly in about two weeks after the egg is laid. It may be well to state that individuals of this same species often differ in size, owing to the fact that some are stunted while in the larval stage.

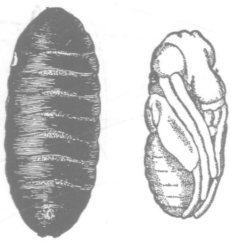


Fig. 6. Housefly puparium and pupa.

It has been estimated that one pound of horse manure is capable of producing 1200 flies. Considering the above estimate and the short period from egg to adult, one can readily account for the innumerable flies especially noticeable during August and September. In the fall of the year when exceptionally numerous, the adult flies die off in great numbers, owing to a fungus disease (*Empusa musca*) which attacks them.

Adult flies pass the winter in the dormant state, many being found concealed in houses as well as in protected locations which provide the required heat. In well heated houses they do not become dormant, but appear sluggish.

In the spring, when warm weather makes its appearance, these flies endeavor to find a suitable place in which to deposit their eggs and thus commences the epidemic of flies which attains its climax during the months of August and September.

METHODS OF CONTROL

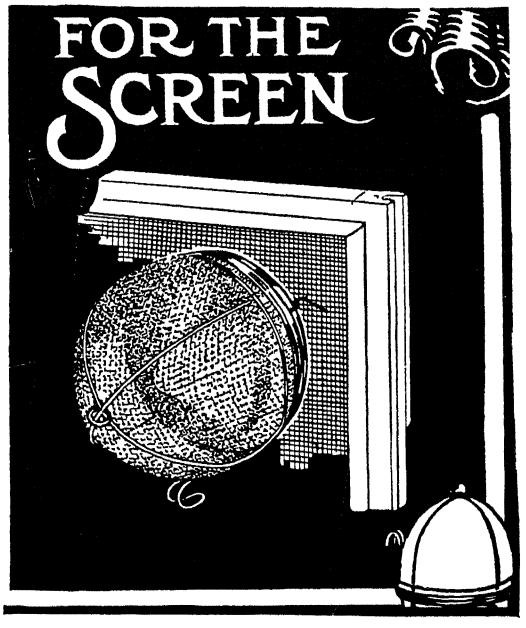
Screening of doors and windows still remains an important means of control as well as does the ever ready fly-paper, although the latter is very disagreeable to have about. It has been discovered that a 2 percent solution of formaldehyde is useful to destroy them. Formaldehyde, which may be obtained at any drug store, should be weakened with water, using twenty parts to one of formaldehyde. This should be placed in flat dishes about the room, preferably in the kitchen and dining room, as these places are favorite haunts for flies. In the evening, the food should be covered, leaving dishes of formaldehyde exposed, as it is the custom for flies to drink water in the morning. Milk or a little honey and vinegar added to the solution is often quite successful in enticing them to it in the daytime.

Sick rooms should be carefully screened and all material containing disease germs should be burned instead of being carelessly left for the flies to swarm over in great numbers.

The house fly can undoubtedly be controlled without any great expense or labor, but to accomplish this end a community must have the cooperation of each and every citizen. All foods, especially uncooked materials, should be kept closely covered. This is especially true of milk, in which disease germs multiply very rapidly.

To drive the pests from the house, darken the rooms by pulling down the shades; then open a door or window and burn pyrethrum powder and the flies will soon make their escape.

Civic societies and municipal authorities should take measures to eradicate this insect which is such a menace to health. It will readily be observed from the foregoing statements that over 90 percent of the flies come from horse manure, and the remainder from garbage cans, human excrement, chicken yards, rabbit pens, etc. In the first place, steps must be taken to provide sanitary methods. Dr. Howard has established that a special receptacle for horse manure is the only remedy to suppress the fly nuisance. This receptacle should be built in some remote corner, for it is a well known fact that flies avoid darkness. It should be kept well ventilated and screened, and the manure must be removed as often as possible—once a week, at least. The floor should be of cement, as it can then be thoroughly cleaned; and the stable should also be provided with a floor devoid of cracks and crevices, as such are breeding places for the flies. The manure should be placed in this closet each day, and it has been recommended that a small shovelful of chloride of lime be scattered over the accumulation of each day. If the above plan is carried out, one will have few flies breeding about the farm.



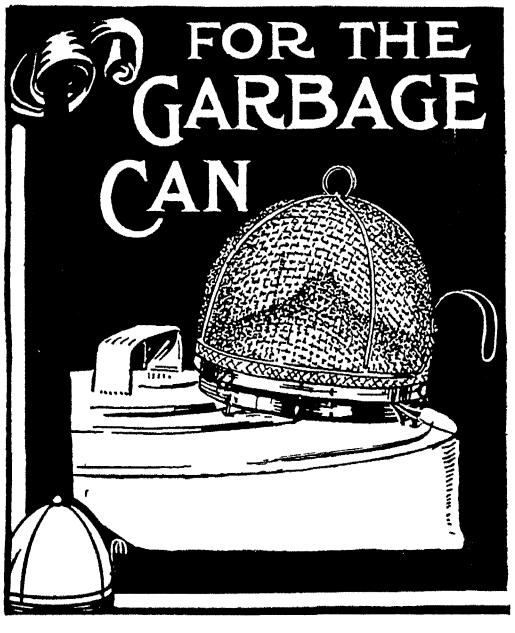


Fig. 7. Hodge Fly Traps.

Another great source of disease is the box privy; this should not be allowed to exist except when it is managed on the kerosene principle. Full directions for building such a privy at a very small expense will be found in Farmers Bulletin, No. 463, Dept. of Agriculture, Washington, D. C. This will gladly be sent to any one requesting it. Make application to your congressman or to the Secretary of Agriculture for it.

Garbage cans should be kept tightly covered and all accumulations of filth should be given strict attention. The authorities of many towns would do well to make an occasional inspection of the public dump. I know of such a dump near a town of several thousand inhabitants to which human excrement from a privy is carried, thereby causing an offensive odor which can be detected some little distance; besides being a menace to the health of those who live within the vicinity.

FLIES OF MINOR IMPORTANCE

The biting housefly* (*Stomoxys calcitrans* Linn.). This annoying species also occurs in houses and, as already stated, resembles to a great extent the typhoid fly, but may be easily distinguished by its piercing mouth parts. It is probably second in abundance to the typhoid fly, and breeds in cow manure, as well as in decaying vegetable matter. It has been surmised that this insect may be an agent by which infantile paralysis is spread, as it has proven to be the most abundant insect found in the vicinity of patients having the disease.

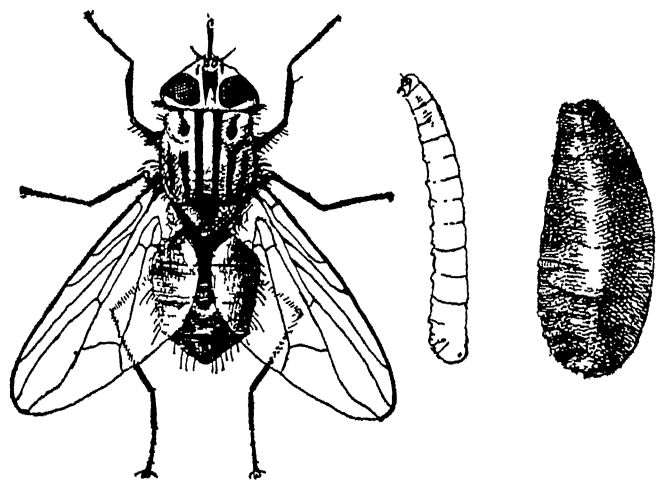


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Fig. 8. Biting housefly, larva and pupa.

*Also quite often referred to as the stable fly. Another species, *Muscina stabulans* is likewise called the stable fly and only the latin name will indicate for a certainty to which species reference is made.

Cluster fly (*Pollenia rudis* Fabr.). This insect is often found during autumn gathering in clusters in houses, and it is from this habit that it derives its popular name. This insect can readily be marked out because of its sluggish movements in autumn, and by its dark, almost black thorax, which is covered with spine-like hairs. Generally it breeds at the roots of grasses, and it has been reported as a parasite on earthworms. In the fall it is particularly subject to a fungus disease which is made conspicuous by powdery spores which are readily seen between the segments of its somewhat enlarged abdomen, also by a circle of spores which surrounds the helpless fly.

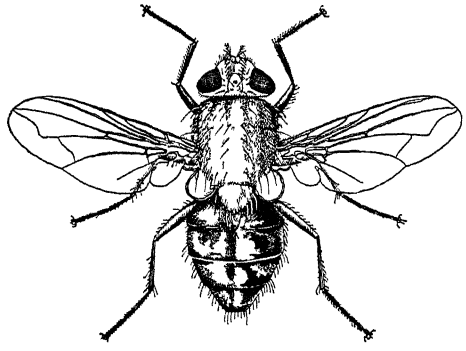

Fig 9. Cluster fly.

Blue-bottle fly (*Calliphora erythrocephala* Meign.). This insect is not very plentiful, but I believe it attracts the attention of the housewife more than any of the other flies. It is very conspicuous owing to its large size and noisy flight. It is a typical meat fly and is commonly known as the meat or blow fly. It deposits its eggs, as a general rule, on or near meat which has become a little tainted, and its larvae develop in this decaying animal matter.

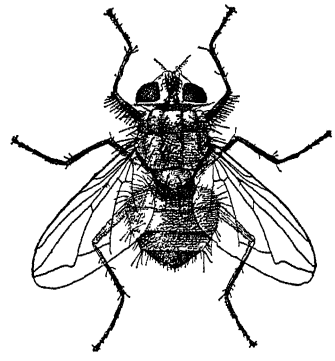

Fig. 10. Blue-bottle fly.

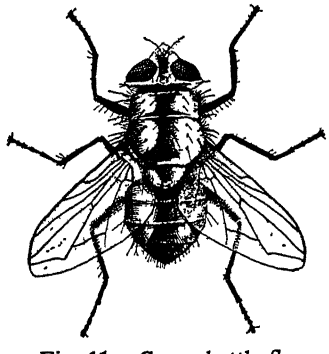

Fig. 11. Green-bottle fly.

Green-bottle fly (*Lucilia caesar* Linn.). This is another flesh fly, and besides in meat is also found breeding in decaying vegetable matter. It is very conspicuous around garbage cans, but seldom attracts attention in houses, probably due to the fact that it prefers the bright sunlight. It is claimed to be a great scavenger.

Fruit flies (*Drosophila sp.*). These are very small, light brown flies, about one-eighth of an inch long, and owing to their size are very hard to keep out of

houses. They are attracted by fruit which has commenced to decay, and as a rule are quite prevalent during the canning season. Fermented liquids, such as cider, wines, vinegar, etc. are also very attractive to them. These flies are rarely present except when some of the above articles are exposed. The remedy is self-evident—the removal of the objects which attract them.

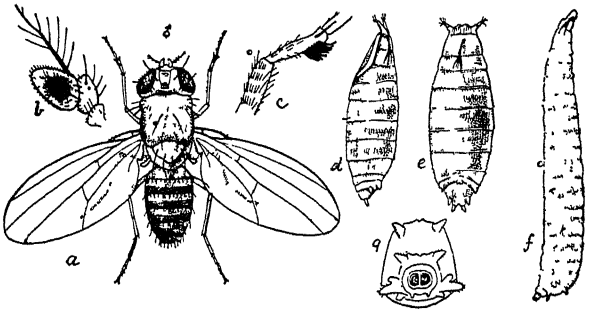

Fig. 12. Fruit fly.

MOSQUITOES

HIBERNATION

Mosquitoes of both sexes generally live through the winter in the adult stage, and some writers state that they may also live over in the larval and egg stages. In seeking out winter quarters, they select almost any kind of sheltered retreat. The degree of cold seems to have little effect upon them as they have been recorded as being present in great numbers in the Arctic region. On the approach of warm weather, the wintered-over females lay their eggs and soon die.

FOOD

The normal food of mosquitoes is, without doubt, obtained from the more juicy of plants. We can readily imagine what a small percentage of these pests are favored with tasting the blood of humans or of domestic animals, if we but stop to consider the large areas of uninhabited swamp and marsh land known to be utilized as ideal breeding places for countless numbers of mosquitoes. The male mosquito is known to be capable of passing through its life without food, but when it feeds at all, its food must necessarily consist of plant juices for its mouth-parts are not adapted for piercing as is the case with the female. The food of the female consists of the blood of birds, domestic and wild animals, bats and reptiles, besides that of humans.

METHODS OF CONTROL

Probably one of the best methods of repelling mosquitoes from houses is by burning pyrethrum. It comes in powder form, and is sold under several trade names, such as Persian and Dalmation Insect Powder. The pure powder, which should always be used, is made from the ground-up heads of certain plants of the genus *Pyrethrum*. One of the best ways to use the powder is first to moisten it, then mold it into small cones about the size of a chocolate drop, and place it in the oven to dry. Fire these dried cones at the apex, and they will smolder slowly, giving off fumes not offensive to man, but distinctly stupefying to mosquitoes, although not necessarily fatal to them. For a good sized living or sleeping room, four or five such cones should be sufficient for an evening. The surest remedy for mosquitoes, however, is the thorough screening of doors and windows. The size of the screen used is of the greatest importance; 15 meshes or less to the inch is not reliable, for some will crawl through. To be entirely safe, one should insist on using nothing coarser than 20 meshes to the inch. If one could find and destroy all the breeding places in the vicinity of houses, there would be little need for either of the above remedies.

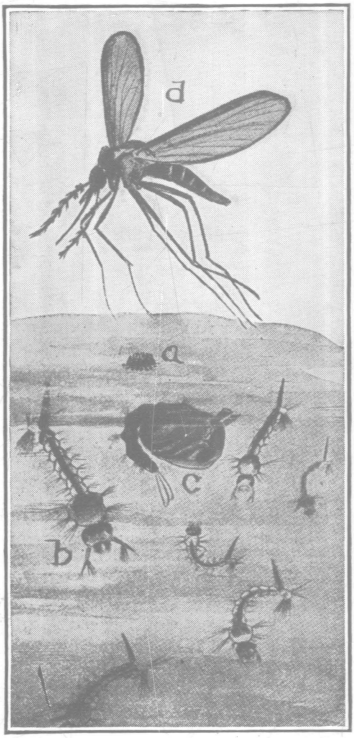

Fig. 13. Life history of a mosquito.

Small areas of water should be treated with kerosene at the rate of one ounce to each fifteen square feet of surface. This will kill all larvae and pupae, also any mosquitoes which may light upon the water. Rainwater barrels, cisterns, and tanks with an open top, used for the storage of water, should be thoroughly screened, or the surface of the water covered over with a thin film of kerosene. Waste places, which are often found in the vicinity of dwelling houses, and also back yards, should be thoroughly searched for receptacles which hold water and these should be destroyed at once. Public dumps are, as a rule, great breeding grounds for flies and

mosquitoes. Every city or town should pass a law that all such dumps should be properly cared for, and, furthermore, see that the law is enforced. Another breeding place is caused by the gathering of water in eaves-troughs. These may be dammed up by various things, probably most commonly by leaves and twigs. This is especially true if the branches of trees overhang the roof. Finally, standing water may be dealt with successfully for the mosquito nuisance in any one of the following ways: By draining; application of kerosene; introduction of fish; artificial agitation; or, by filling in with earth. A few drops of spirits of camphor or of oil of pennyroyal is said to be very good to keep away mosquitoes when retiring at night. Use the above substances by sprinkling or sponging over the face, hands, and pillow.

THE MALARIAL PARASITE

Prior to fifteen or twenty years ago, the cause of malaria was unknown. Previously it was thought to be due to the condition of the atmosphere, especially over swampy regions. On breathing this air, it was supposed that one became infected with the disease. This idea that the disease originates in the atmosphere is carried out in its name, which is from the Italian and means "bad air." The parasites of malaria were first found in the human blood in 1880 by Laveran, a French surgeon. He did not, however, determine how these parasites entered the blood. Some years after Laveran's discovery, Calli, an Italian, noted the great numbers of mosquitoes occurring coincidently with the outbreaks of malaria. Since his time, it has been proven by Ross (1898) that certain mosquitoes of the genus *Anopheles* are the agents which spread the disease. Thus, it will be seen that one of the most common of diseases may be prevented by eradicating the disease-carrying mosquitoes. These organisms of malaria are taken up by the mosquito and, after going through certain stages of development in its stomach, make their way to the salivary glands, where they remain until the mosquito feeds again. On biting the next person, the mosquito injects some of the developed parasites into the blood with the fluid of the salivary glands. This fluid is injected into the puncture as a thinning agent for the blood, so as to make it flow

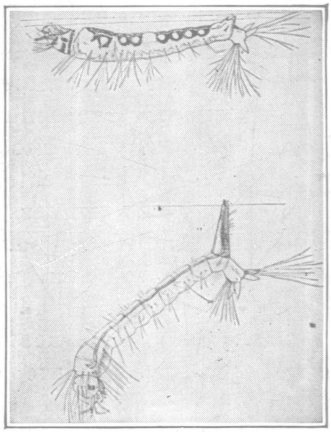

Fig. 14. Half-grown larvae of Anopheles and of Culex

freely. After a short time these organisms reproduce, and, unless the person attacked is immune, he soon has an attack of malaria. Malarial mosquitoes must first bite someone having the parasites in his system before they can infect a well person with the disease. Medical men have definitely proven that these germs of malaria have to pass through certain stages of development in the mosquito before they can cause a case of malaria; therefore, it is readily seen that the malarial mosquito is harmless unless it has first taken the blood of someone having such germs in his system.

DISTINGUISHING DIFFERENCES

A malarial mosquito of the genus *Anopheles* and a common house or rainbarrel mosquito of the genus *Culex* differ from each other in several ways. In the first place the common mosquitoes have clear wings, and when at rest, the body is in a line parallel to the supporting surface. On the other hand, the malarial mosquitoes have smoky wings, and when at rest, the body forms an acute angle with the supporting surface. The eggs of *Culex* are oval, black, very small, not nearly as large as the head of an ordinary pin, and are laid in closely united, raft-like masses composed of a large number of eggs, usually varying from 200 to 400. The eggs of *Anopheles* are never laid in raft-like masses as is the case with *Culex*. Instead, their eggs are deposited in groups of from 50 to 100, all being superficially connected when laid, and these soon break up into smaller groups, usually varying in number from one to ten. The eggs, in both instances, are somewhat longer than broad. In the case of the *Anopheles* mosquitoes, the eggs are placed end to end; on the other hand, mosquitoes of the genus *Culex* lay their eggs side by side. Under favorable conditions, the eggs hatch in one or two days from the time of laying. The larva of the common or house mosquito has a large air tube at its posterior end, and rests with its body at a distinct angle to the surface of the water; on the other hand, the larva of the malarial mosquito has no conspicuous air tube at its posterior end, and rests with its body in a horizontal position, parallel to the surface of the water. Under favorable conditions, the life cycle from egg to adult may be completed in about two weeks.

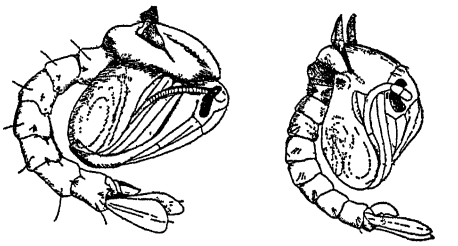

Fig. 15. Pupa of Anopheles and of Culex.

MISCELLANEOUS FACTS

It is not the male mosquitoes that do the biting, for their mouth-parts are not made for piercing. On the other hand, the female is provided with piercing mouth-parts, and it is she alone that is such a pest to man. Mosquitoes generally commence to fly after sunset, and continue to annoy people until late in the evening, sometimes until midnight, and may continue their work indoors all night. During the day, they generally seek a secluded place away from the sunlight, usually in cool places amongst dense foliage. The male mosquitoes live but a short time, while the females may live for months. The bite of the mosquito is not painful to some people, while others suffer considerably from it. The parts bitten may become swollen and inflamed, and the itching often lasts for several days. The latter class of people should either apply ammonia to the puncture, or take a piece of soap, moisten, and rub gently over the affected area; either of which remedies will generally relieve the itching.

THE BUFFALO MOTH OR CARPET BEETLE

(*Anthrenus scrophulariae* Linn.)

The name "buffalo moth" was undoubtedly invented by the vivid imagination of some one who saw some similarity between the tuftings of the small grub and the mane of the buffalo. The erroneous and misleading term "moth" in all probability was coined from its feeding habits which are similar to those of the clothes moth. The adult insect is a small, distinctly convex, black, grayish-white, mottled beetle, measuring about one-eighth of an inch in length, having the inner margin of each wing-cover marked with a narrow red line, this bearing three short projections extending laterally. This insect is of European origin, having been first noticed in this country about 1874. The last brood of adult beetles commences to appear usually about October, and I have seen them crawling about in winter in well heated houses, but as a usual thing they are seen most abundantly in the springtime when they commence mating and laying eggs for the next brood. At this time they are frequently seen crawling on windows where, if given

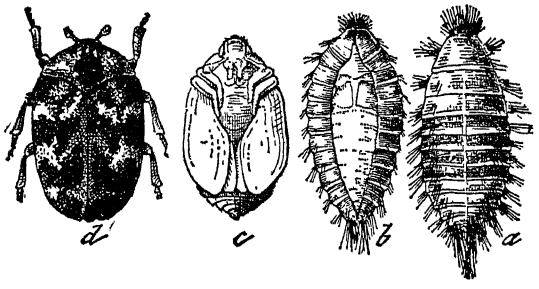

Fig. 16. Buffalo carpet beetle.

the opportunity, they will fly out. Normally, these insects hibernate in some protected place out of doors, as under the bark of trees, and in May or June fly to some favorite flowering plant. They are especially fond of Spiraea blossoms and, no doubt, these flowers, when cut and carried into dwellings, or when located near unscreened windows, produce new infestation. When disturbed, the beetles instantly feign death. The eggs hatch in a few days and the young grubs commence feeding. This species has been known to feed upon furs and feathers, but preferably upon woolen goods, so located that they are but seldom disturbed, as when in storage. They are also known to feed upon the woolen fibre along the underside of carpets, especially in floor cracks. The grub is stout and active, about one-fifth of an inch long, and clothed with coarse, brown hairs. The lateral margins of each segment bear tufts of hair of the same color, but at the extremities of the body are borne two much larger tufts. From two to three broods occur yearly.

METHODS OF CONTROL

It is a well known fact that these insects are seldom found in houses having polished floors, covered only with rugs, while, on the other hand, houses the floors of which are covered with carpets that are removed but once a year, are more liable to infestation. Therefore, it is advisable to do away with unmovable carpets if practicable. Woolen goods, furs and rugs, when not in use during the summer, may be packed away with safety in clean pasteboard boxes, if sealed tightly with strips of paper. Placing articles liable to infestation in paper bags, or wrapping the same carefully in paper, has often proven very satisfactory. Frequent brushings and airings of winter clothing during the summer months, will do much toward preventing these insects from getting a foothold. Articles placed in storage, the temperature of which does not rise above 40 degrees F., are claimed to be entirely safe from attack. Carpets becoming infested, should be taken up and steam-cleaned, since this destroys all eggs as well as the larvae. The floor should then be thoroughly cleaned and the cracks soaked with gasoline before the carpet is put down again. When it is not possible to remove the carpet, one may apply a liberal amount of gasoline to the affected areas, or place a moist cloth over the spot showing the presence of beetles, and then pass a hot iron over the same, thus killing all the insects by the steam thus generated. One must be very careful in using gasoline or benzine not to have any fire present, as both substances are highly inflammable. Fumigation with hydrocyanic acid gas, when practicable, is undoubtedly a very satisfactory method of exterminating this pest. Sulphur dioxide generated by burning

flowers of sulphur is one of the fumigants used, but owing to its blackening effect on silver, and the changing of tints of wall paper, etc., it is not considered as being practical in all cases. Carbon bisulfide will also kill these insects, but it is a dangerous substance to use on account of its inflammability. (Directions for using the above materials, pp. 149-150). Naphthalene may be used as a repellant. Spraying with benzine or naphtha two or three times daily during warm weather is advisable.

THE BLACK CARPET BEETLE

(*Attagenus piceus* Oliv.)

The adult is a small, black or rusty-black, slightly downy beetle, larger and proportionately more elongated than the buffalo carpet beetle. It measures about 3-16 of an inch in length by 3-32 of an inch in width. This species is of European origin and was first recorded in this country as attacking carpets in 1879 by Dr. Lintner of New York. They are sometimes found upon flowers in June and July, and in many other respects have similar habits to the buffalo beetle. The full grown grubs of these insects measure about 5-16 of an inch in length, are reddish-brown in color, and slightly clothed with hairs, somewhat cylindrical and tapering posteriorly, and are readily characterized by the presence of a tail-like appendage of reddish-brown hairs, usually exceeding half the body-length. Grubs of the insect have been reported as feeding upon carpets, woolen goods, feathers, silks, cereals (such as meal and flour) and other seeds.

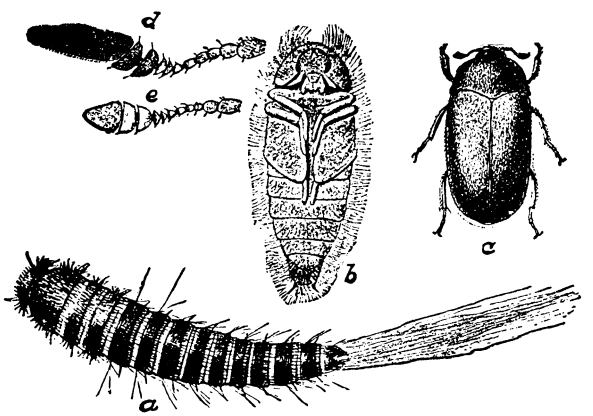

Fig. 17. Black carpet beetle.

Methods of control,—same as for the buffalo carpet beetle.

THE MUSEUM PEST

(*Anthrenus verbasci* Linn.)

The above insect is often found feeding upon dried vegetable and animal products of various kinds. It is especially fond of working on the dried hides of animals and the skins of stuffed birds.

The museum pest is often found on the flowers of wheat and is, as a rule, smaller than its near relative, the buffalo carpet beetle, which frequently occurs out of doors on Spirea blossoms. At a casual glance it appears to be of a mottled, brownish-gray color, but on close examination it will be found to be a blackish beetle mottled with gray and yellowish scales. It occurs most frequently in the adult state from March first to June first, depending upon the surrounding conditions.

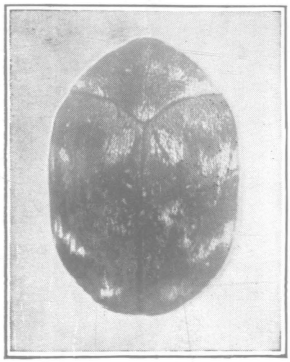

Fig. 18. Museum pest.

METHODS OF CONTROL

About the simplest method of exterminating this pest consists in fumigating with carbon bisulfide as recommended for various other household pests (See directions, pp. 149-150). Moth balls or naphthalene will act as a preventive, but will do no good after infestation has already taken place.

THE CASE-MAKING CLOTHES MOTH

(*Tinea pellionella* Linn.)

Two other species, the webbing or southern clothes moth, (*Tineola biselliella* Hum.) and the tapestry moth, (*Trichophaga tapetiella* Linn.) occur in the U. S., but so far as I have been able to determine, they rarely occur in this state. Our common form is the case-making moth and was first noted in this country (Philadelphia) as early as 1743. These moths, or millers, as they are sometimes called, are harmless in themselves so far as the eating of fabrics goes, for their mouth-parts are unfitted for feeding, the mission of the adults being simply to reproduce the species, but their presence should be taken as an evidence of larval infestation. As they are night-fliers, one sees them flying about at dusk or during the evening in some dark corner of the room, but they are seldom seen during the day, except when disturbed from their hiding places. The adult insect is small and delicate, having a wing expanse of nearly 2-5 of an inch. Its forewings are yellowish-gray, marked with a few small, undefined brownish spots and fringed towards the outer portion of the posterior margins. The hind wings are of a uniform size, having more or less of a shining, silvery-gray color, about ⅔ the length of the forewings, and its posterior margin has a wide fringe which gradually increases in length from the apex or outer portion of the wing towards the base or wing attachment.

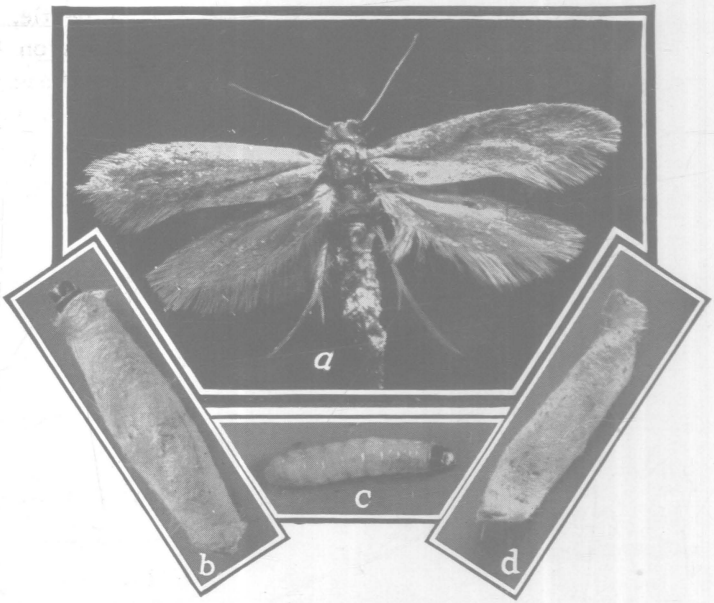

Fig. 19. Case-making clothes moth.

These moths usually lay their minute, white eggs in some dark corner or closet, on or near carpets, woolen goods, or furs, and the minute, brownish-headed white caterpillars commence feeding at once, at the same time constructing a small, bag-like case, which is externally made up of small woolen fragments or other material and internally is lined with a whitish silk. The caterpillar never leaves its case after it is once formed, the case being enlarged from time to time as the caterpillar increases in size. The caterpillar accomplishes this enlargement without leaving its case by making a slit down one side, and then down the other, filling in the same with wedge-shaped pieces of material. By reversing its body, it is enabled to enlarge the case at both ends. It shows a great preference for the reds found in fabrics. This bag-like case distinguishes the species at once from all others of similar habits. On becoming full grown, it either attaches its case to the material on which it is working, or crawls to some protected place where it attaches itself by silken threads, and then retires within its case, closing up the entrance, and changes to a pupa. The moths usually appear most abundantly during July and August. There is in all probability one brood per year here in Ohio, and the larva, according to Prof. C. H. Fernald, never occurs in winter in the north, even in well-heated houses.

Method of control,—same as for carpet beetle.

COMMON HOUSE ANTS

Little red ant (*Monomorium pharaonis* Linn.). So far as I am able to find out, the geographical origin of this species is unknown, but it is probably an importation, like many other species of ants. This is strictly a house species and undoubtedly is the most detested, troublesome and prolific of the species occurring in houses. Its minute size, being only about 1-20 of an inch long, enables it to make its way through very small openings. This species is capable of passing, and usually does pass its entire life history within the house, making its nest, as a rule, in places that are very hard to reach, such as between partitions and under the flooring.

Small black ant (*Monomorium minutum* Mayr.). This species is about 3-16 of an inch long, and unlike the preceding, it is not strictly a house species, as it usually builds its nest out of doors under stones, also in the open, and I have seen them emerging from between old brick-work which had begun to crumble, or from the side of a house near the ground. This species often enters houses in great numbers, and as a rule ranks second in importance to the preceding form. The outdoor nests of this insect are characterized by a small, hollowed-out mound of earth, which the ants throw out of their underground tunnels.

Two other species of ants, of minor importance, sometimes find their way into houses where they make raids upon articles of food. The most common of the two, and one which, at times, has been known to rival its smaller black relative in point of numbers and in amount of damage done, is known as the black pavement ant (*Tetramorium caespitum* Linn.). This species is about ⅛ inch in length and, as its popular name would lead one to infer, commonly makes its home out of doors under pavements and in similar locations, being, therefore, very hard to reach in many instances. The other species, which frequently makes its nest within the house, in timbers and like structures, is the largest of them all, measuring ½ inch or more in length, and is normally a wood-feeder. It is scientifically known as (*Camponotus herculeanus pennsylvanicus* Deg.)

METHODS OF CONTROL

Fumigation with hydrocyanic acid gas is advisable in old and badly infested houses, especially for those forms which build their nests behind walls, under flooring, in timbers and such places. (Directions, pp. 149-150). One can easily exterminate those forms which make their homes out of doors by finding their nests and saturating the upper layers of soil with a solution of potassium cyanide made up at the rate of one ounce to each gallon of water. One must be

very careful, however, in the use of this substance, for the smallest fragments of crystals, if left lying about, may be picked up by chickens or other animals and cause death. Other methods of exterminating these insects, when their out-door nest can be found, consist in pouring carbon bisulfide into holes 3 or 4 in. in depth, made by punching the end of a hoe handle or a sharpened stick into the ground. If the nest is large, the holes should be punched several inches apart. These holes should be covered with fresh earth immediately after applying the carbon bisulfide. An application of boiling water, kerosene, or gasoline, will often accomplish the same results, if applied in sufficient quantities.

Trapping by means of sponges, moistened with syrup, sugar water, or other attractive substance, will do much to rid the place of ants, if carried out faithfully and persistently. Be sure, however, that all other attractive substances outside of the sponges are covered up or put out of their reach. When these trap sponges become filled with ants, drop them into boiling water, then wash out thoroughly so as to get rid of all of the dead ants and odor; then repeat as before. To keep ants from climbing up table legs, getting into refrigerators, etc., place the legs or supports in small dishes of kerosene and be sure that the article of furniture does not touch anything else, up which the ants may crawl. The odors of carbolic acid, naphthalene and gasoline are said to be objectionable to them, and when sprinkled about their haunts, these substances are said to do much towards driving them away.

COCKROACHES

Roaches are most commonly found in old, ill-kept houses and are undoubtedly among the most offensive and disgusting of all household pests. They prefer, as a general rule, a warm location in the house; thus, kitchens and pantries make excellent quarters where they may breed and feed. During the day they find concealment behind wainscoting, etc., especially back of or in the region of the fireplace. These roaches feed on food materials of all kinds, and are especially fond of the paste used in the binding of books. The greatest damage they cause is, perhaps, not due to the amount of food eaten, but to the offensive, roachy odor which this insect leaves on everything with which it comes in contact. They have been reported as feeding upon bedbugs and, if this is a general habit, it is surely a redeeming quality, but to my mind one pest is nearly as bad as the other. I have also seen them prove cannibals and eat one another, but in most cases the victim has been one that was feeble or disabled in some way. The eggs are not laid singly, as is

the case with many insects, but they are brought together inside of the abdomen of the female into a hard, pod-like structure (*Ootheca*). The shape of this pod-like structure varies according to the species, being, as a general rule, more or less elongate or oval. These pods are often seen protruding conspicuously from the abdomen of the female, and remain in this position some time before they are deposited. The immature insects, from the first, generally appear much the same as the adults, excepting that they are much smaller and lack wings. They molt, that is, shed their skins, generally from five to seven times; each time the insect escapes through a slit along the back, coming forth soft and white, but it soon changes in color, and at the same time the skin becomes hardened. Development takes place very slowly, and, under ordinary circumstances, it does not become full grown until the end of the year. This time varies somewhat, depending upon the temperature and food; that is, whether the conditions are favorable or not.

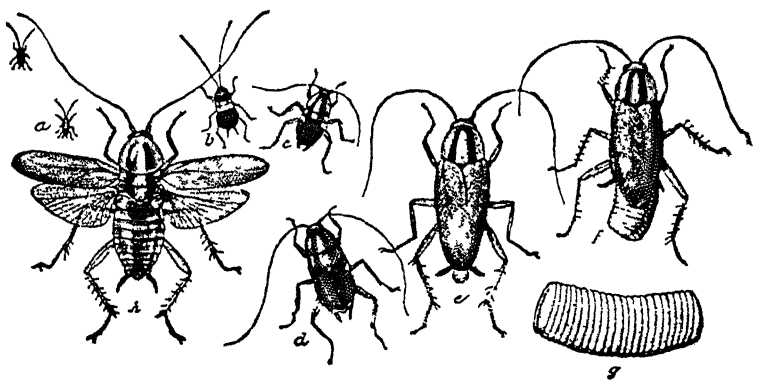

Fig. 20. Croton bug.

From the above remarks, it can be observed that it is not the rapidity with which they multiply which accounts for an abundance of roaches, but their great numbers is due to the fact that they have but few natural enemies; then, too, it is very hard to destroy them with ordinary traps and poisons. It is very peculiar that an insect which will eat so many food stuffs will detect the very slightest traces of arsenic in any food and abandon such poisoned bait. This is especially true of the Croton bug. There are thee species of cockroaches commonly found in Ohio, namely, first, the Croton bug (*Blatella germanica* Linn.). This is a German roach and received its popular name in this country from its early association with the Croton waterworks system of New York City. It is of a light brown color with dark, brownish-black markings. It is

somewhat less than an inch in length when full grown. Second, the **Oriental cockroach** or "black beetle" (*Blatta orientalis* Linn.) is a common European species. It is black and measures one inch or over in length. The female has but rudiments of wings, while the wings of the male extend from ½ to ¾ the distance to the end of the abdomen. Third, the **American cockroach** (*Periplaneta americana* Linn.), the least common and by far the largest roach which occurs in this state. It measures approximately two inches in length. This species is of a striking reddish-brown color, and has well developed wings which extend beyond the tip of the abdomen in both sexes. As a native species, it seems to be confined to mills, stores and warehouses. I have seen them in great abundance about meat packing-houses. All the species are much flattened and thin, and are provided with long, slender feelers and spine-covered legs. These species are nocturnal in habits, preferring, as a general rule, a dark or secluded place during the day. However, it is not uncommon to see our most active species searching for food or scurrying about in daylight.

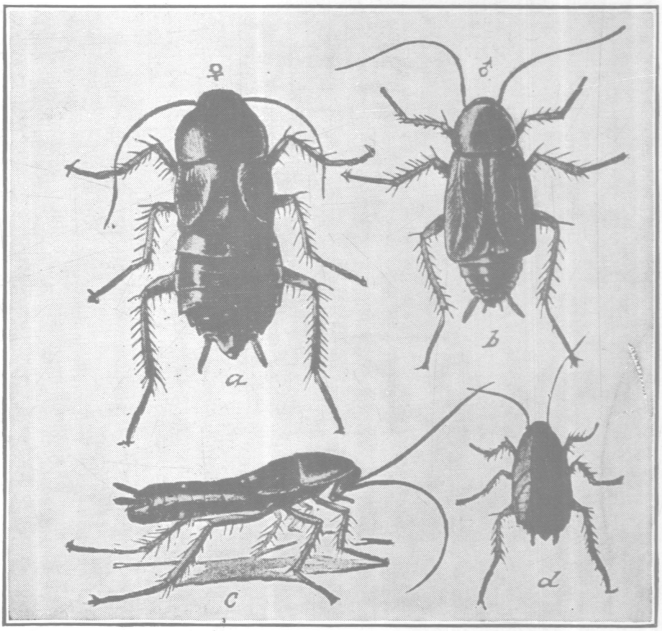

Fig. 20. Oriental cockroach.

REMEDIES

In the first place, I recommend that a house showing but slight infestation be subjected to a thorough cleaning, killing all the roaches that can be found. Then all cracks and crevices offering

places for concealment should be filled with putty or some similar substance of equal value, thereby destroying their hiding places. In badly infested dwellings or storehouses, fumigation with hydrocyanic acid gas will be found the quickest and best method of extermination. One must be very careful, however, in using this fumigant as it is one of the most deadly of gases, and if a person should inhale very much, immediate death would result. See directions for fumigation on p. 149.

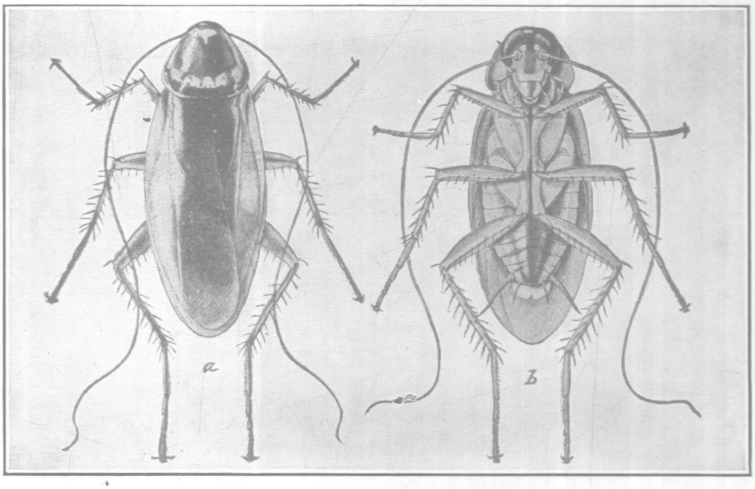

Fig. 22. American cockroach.

The following remedies are frequently advised and are said to give very satisfactory results. Mix equal parts of sweet chocolate (sugar sometimes substituted) and borax ground in a mortar, then scatter this about in the haunts of the roaches. The creatures, eating this sweetened bait, are eventually killed by the borax.

Phosphorus paste, which can be obtained at drug stores, is claimed to be another satisfactory remedy, at least for the large species. Burning pyrethrum in infested compartments is very effective in destroying roaches. The room should be closed for about ten or twelve hours.

Carbon bisulfide may also be used as a fumigant and will undoubtedly prove satisfactory if used in sufficient quantities. One must, however, bear in mind that it is very inflammable, and must never be used in proximity to fire of any kind. (See fumigation directions, p. 150) The Croton bug is less amenable to the treatments recommended than the other species.

COMMON WOOD COCKROACH

(*Ischnoptera pennsylvanica* De G.)

This is our common out-door cockroach, which is frequently found in the woods under damp, decaying bark of old logs. The mature or winged insect is light brown in color; the lateral margins of the pronotum (portion of the body just behind the head) are much lighter than the central portion, while the basal portions of the wing-covers, which extend beyond the tip of the abdomen, are similarly marked. This light margin of the wing-covers gradually fades out towards the apex of the abdomen. The body of this insect is about one inch long, and much more slender than the species of *Periplaneta* previously mentioned.

These insects are attracted by lights in summer, and frequently enter farmhouses and summer cottages along lakes and streams, near or in a wooded area. After once entering a house, they proceed to do considerable damage, similar both in situation and character to that of other household cockroaches.

METHODS OF CONTROL

Screening of doors and windows is one of the best methods for keeping these insects out, but when once estabished, treat the same as for other roaches.

BEDBUG

(*Cimex lectularius* Linn)

Perhaps bedbugs, together with cockroaches, are detested far more than any other pests, especially by the housewife. This insect is, to be sure, found most commonly in ill-kept houses, but no disgrace attaches to their appearance if they happen to come into any house, for they are easily introduced. Deserved disgrace, however, should come for not getting rid of them just as soon as possible after they are detected.

One is liable to get them in his clothes or suitcase while in hotels, sleeping cars, state rooms of boats, or other puplic conveyances. The bedbug also has a habit of migrating from infested houses to others nearby, and this is especially true if the occupants of the infested house move away.

These insects are able to go without food for long periods of time and, in occupied houses, there is no telling how long they would be able to survive without tasting the blood of humanity. This insect belongs to the same order (Hemiptera) of insects as the well known squash bug, the chinch bug, and the various stink bugs with which most everyone has had some experience. The bedbug

obtains its food by puncturing the skin with a small, tubular beak known as the proboscis, through which it sucks its food. The adult bedbug is about one-fourth of an inch long, flattened, and reddish-brown. It is also wingless, like so many of the parasitic forms of insect life occurring on animals. Disuse of the wings through many successive generations has doubtless caused them to first become atrophied and then to disappear. The insect still has very small pad-like structures or mere rudiments of wings which are not noticeable, except by a very close examination. It is about one-half as broad as long, and has a very characteristic, as well as disagreeable, odor. The body of the bedbug is soft and flexible, thus making it possible for it to force its way into very small crevices. Like the cockroaches, bedbugs are nocturnal in habits, generally coming out after people have retired for the night. After feeding on the sleeping individual, they again conceal themselves in some secluded crack or crevice, which may be in the wooden frame of the bed, in the window frame, in the mouldings of the room or of picture frames, or beneath any kind of wall paper.

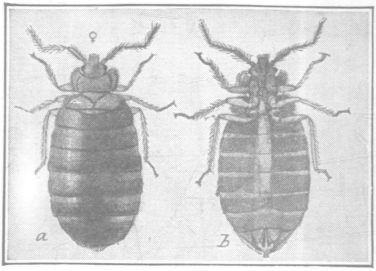

Fig. 23. Bedbug.

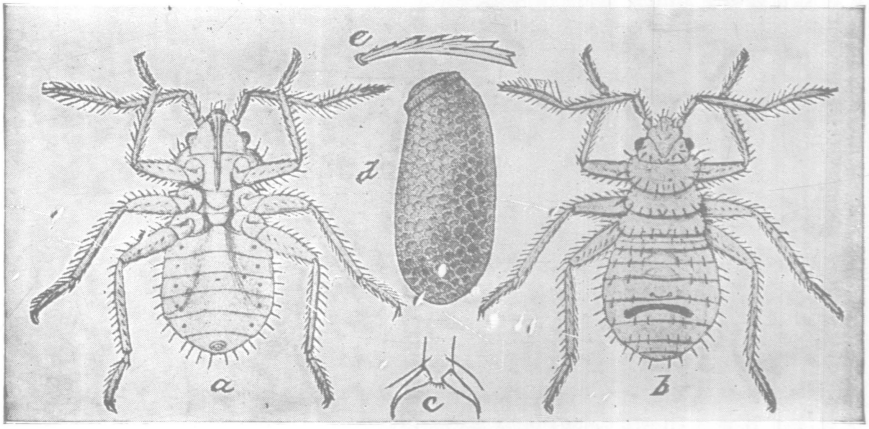

Fig. 24. Egg and newly hatched larva of bedbug, ventral and dorsal view.

I have seen them gathered in great numbers behind a large framed picture which was hanging on the wall, just above a bed. This bug lays small, whitish, oval eggs in small masses in its hiding places, and as the female may lay several masses, we obtain from a very few specimens a great number of insects during a year.

These eggs are usually hatched within one or two weeks, the young emerging as very small, whitish creatures which much resemble the adult insect. They change in color as growth advances. This insect molts five times before reaching the adult stage, and it is stated that they feed but once between each molt. We will have, therefore, a variable length of time before the adult stage is reached, depending wholly upon the availability of food. When they are able to obtain food readily and at any time, it usually takes from one to two weeks between the molts. At the last molt, the wing-pads are developed, these being characteristic of the adult.

REMEDIES

Rooms becoming infested with bedbugs should be subjected to a thorough examination, and each article of furniture, the woodwork, and, in fact, everything in the room should be carefully looked over. Every crack and crevice should be given a generous application of gasoline, and in the absence of the latter, kerosene has been found very effective. Gasoline will hurt neither clothing nor paper, and it is, therefore, one of the best of household remedies. However, as this will not destroy the eggs, it will be well to follow up the first application with another about two weeks later. Modern houses, with tight construction, and the use of iron and brass beds has lessened the retreats of bedbugs and they are, consequently, easy to control as compared with what they were in the bygone era of rambling, old-fashioned houses and wooden bedsteads, with their cracks and crevices.

Badly infested buildings and rooms should be subjected to fumigation either with sulphur or with hydrocyanic acid gas. See directions, pp. 149-150.

FLEAS

(*Ctenocephalus canis* Curt.)

Fleas found in houses are, as a rule, nothing more nor less than the species commonly called the "cat or dog flea," this insect being common to both animals. These adult insects are wingless and have the body strongly compressed laterally. They are provided with sucking mouth-parts, and the hind legs are greatly developed, thus enabling them to jump considerable distances. The female flea lays its small, whitish eggs amongst the hair of the cat or dog, from whence they are scattered, and the young develop in cracks, under carpets, etc. They are very frequently found breeding in cracks or crevices containing dirt, especially if in close proximity to the sleeping places of cats and dogs. The eggs hatch after several days and the young feed on either vegetable or animal matter which is

always present in such places to a greater or less extent. The young larva is very similar in appearance to the maggot of a small fly. In fact, these insects were at one time considered as belonging to the same order as the flies. These maggot-like young become full grown, ordinarily, in about two weeks; spin silken cocoons; change to pupae; and finally emerge as adults in one or two weeks, depending upon the temperature. They pass the winter in the adult stage and possibly in the other stages of development also.

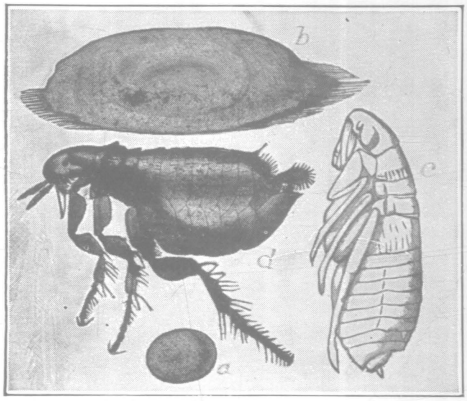

Fig. 25. Dog or cat flea.

One will perceive from the above, that it is possible to have at least one brood develop per month. Under exceptionally favorable conditions we might get two broods during a month in summer. Often, when providing summer quarters for a dog, one neglects to thoroughly clean out the sleeping place it occupied through the winter and spring months. Under such circumstances, fleas may become exceedingly abundant in a short time. In the absence of their customary host, they may spread over the house, searching for food, and they will not hesitate to attack mankind, usually showing a preference for the lower part of the legs. They may produce considerable annoyance, their bite being exceedingly irritating to some people.

REMEDIES

Frequent cleaning and airing of the sleeping quarters of dogs and cats, besides cleaning the carpets and rugs, will do much to prevent an outbreak of fleas in the house, as they do not flourish when much disturbed. Pyrethrum powder scattered in the dog box, occasionally, will prevent the breeding of fleas. My experience has been that about the easiest and surest way to keep a dog free of fleas is to give him frequent baths in water containing a small amount of creolin or carbolic solution of some kind. Carbolic soap is also good to use for washing dogs. Houses, becoming infested, should be thoroughly cleaned and gasoline should be injected into the cracks to kill all the larvae and pupae. If they have become badly infested, and one finds it impossible to reach the breeding places, it probably would be advisable under some circumstances to fumigate

with hydrocyanic acid gas (See directions, p. 149.). It may be said also, that when animals, either dogs or cats, are given free run of the house, persons are seldom attacked, owing to the fact that these insects will not bite humans, as a general rule, when they have access to their ordinary host. By washing the dog frequently, and letting him run through the house to collect the scattered fleas, one can often reduce the pest almost to the point of eradication in a very short time.

HEAD LOUSE

(*Pediculus capitis* De G.)

This is the most common species of louse that attacks man. It has been given its popular name from the fact that it is generally found on the scalp, although it has been reported as working among the hairs of the beard.

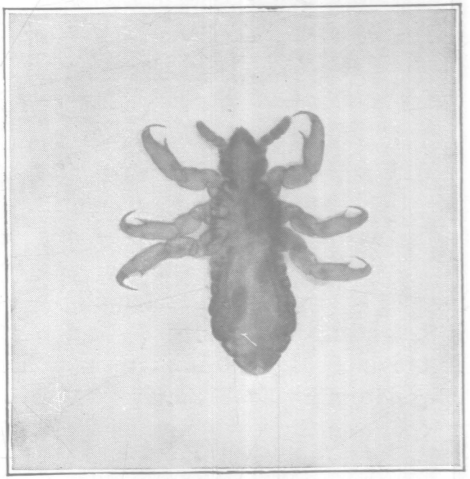

Fig. 26. Head louse.

It is a small, wingless, sucking insect, strictly parasitic in habits, belonging to the same order as the bedbug. The loss of wings is undoubtedly the result of parasitism. They obtain their food by first puncturing the scalp and then sucking the blood. The nits or eggs are cemented firmly to the hairs by a substance secreted when the eggs are laid, and as a general thing they are to be found some little distance from the scalp. One will always find these nits especially plentiful about the ears. The eggs hatch in about a week.

REMEDY

The lice may be removed by thoroughly combing the hair with a fine-toothed comb, but this treatment will not ordinarily dislodge the closely adhering nits. Vaseline rubbed into the hair will often do much to rid the head of the pest, as this clogs the breathing pores of the lice. It has been stated that washing the hair several times with weak vinegar will destroy the nits. Druggists sell a mercurial ointment, blue ointment, or "Blue-butter" as it is sometimes called, which, when applied to the scalp, is very effective.

Whatever the remedy used, it should be repeated several times at intervals of two or three days for about two weeks, to make certain that none of the newly hatched individuals escape.

CRAB LOUSE

(*Phthirius inquinalis* Leach)

This insect, although not found as commonly as the head louse, is not a total stranger by any means. It differs greatly in appearance from the other species attacking man. It is nearly as broad as long, having the appearance of a minute crab. These little crab-like insects are found particularly in the pubic region, but are also sometimes found among the hairs of the chest, beard, eyebrows, or armpits.

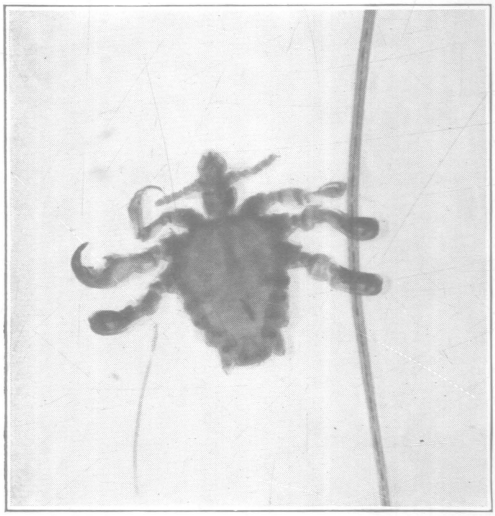

Fig. 27. Crab louse.

This insect causes severe irritation to most people that happen to be attacked. The eggs are laid attached to the hairs. It is provided with claws which enable it to cling to a hair rather tenaciously, in fact, it is almost impossible to remove the insect without also removing the hair to which it clings.

One is liable to pick up these insects in public toilet rooms, such as in hotels, college dormitories, steamships, railroad cars, public schools, etc.

REMEDY

The best remedy known is the mercurial ointment applied freely and frequently to the infested parts until all irritation ceases.

BODY LOUSE

(*Pediculus vestimenti* Leach)

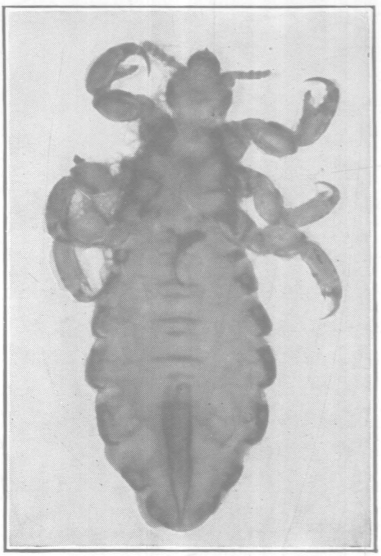

Fig. 28. Body louse.

This insect occurs in dirty, ill-kept lodging houses, camps, and similar places where filth abounds. They are also known as "gray-backs." The body louse is somewhat similar in form to the head louse, but is much larger. It usually lives in the seams of clothing, next to the body, from whence it sucks the blood.

The eggs which are laid on the clothing are very resistant and, therefore, the clothing must be boiled for a few hours. The application of dry heat, 150 degrees F., is said to kill all the insects as well as the eggs.

BOOK LICE

(*Atropos sp. and Clothilla sp.*)

These insects have received their popular name from a habit they have of infesting old books and papers, and they have also received the name of "death watch," owing to the peculiar ticking noise which they make. These wingless and almost colorless species are so small that they are but just distinguishable to the unaided eye. They are sometimes found amongst clothing, especially starched linens which have been laid away for some time, and frequently they occur in great numbers in mattresses. When they are discovered running over the sheets of the bed overlying an infested mattress, the housekeeper is generally greatly alarmed, thinking that she has an infestation of some of the true lice which attack man. However, these insects are entirely different from the true lice. They are much smaller, belonging to the order Corrodentia (biting insects) and their food consists principally of starchy materials with, no doubt, some other dried vegetable and animal matter, while the true lice belong to the Hemiptera (sucking insects).

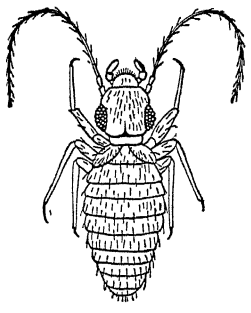

Fig. 29. Book louse.

Book lice move very rapidly when disturbed, while true lice are very sluggish crawlers. On the head of these insects, one will find two very long feeler-like organs, called antennae. The antennae of sucking or true lice are very short, barely discernible without a magnifier.

REMEDIES

These insects do not generally occur in places frequently used, especially if such rooms are well lighted and ventilated, but when an infestation is discovered a thorough scrubbing of woodwork and of furniture and a dusting and brushing of bedding and of clothing should follow. This method of cleaning should be supplemented by a liberal application of gasoline in such cracks and crevices as are not easily reached by ordinary cleaning.

The use of Naphthalene in some form or other in boxes and drawers used for the storage of articles, will undoubtedly do much to keep these insects out. Lastly, infested mattresses, stuffed with either

corn husks or straw, should be ripped open and the contents burned. On the other hand, hair mattresses, as a general rule, will be worth the trouble and expense of steam cleaning, thus killing all the insects.

SILVER FISH OR FISH MOTH

(*Lepisma sp.*)

This extremely delicate, wingless, chewing, silvery-gray creature which sheds a glistening, grayish powder (minute scales) on the fingers, when touched, belongs to the lowest order of insects (*Thysanura*). These insects are less than one-half inch in length, and the head bears two long feelers (antennae) while the posterior extremity of the body shows three long, slender organs (anal filaments) of nearly the same length as the head appendages.

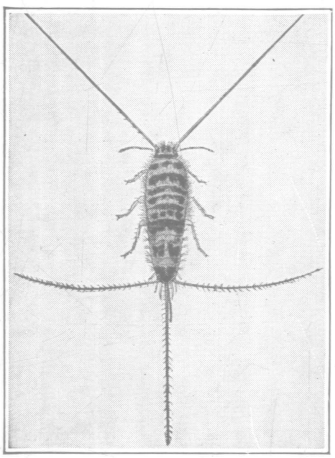

Fig. 30. Silver fish.

This pest prefers darkness to light, and is most frequently found amongst undisturbed books, papers, or starched linens, where it may obtain its food which consists of starchy materials. Considerable damage is oftentimes done to the binding of books in old libraries. Upon opening a book suddenly or bringing a light into the infested quarter, one may often see these small, torpedo-shaped insects darting quickly to concealment in some crack or crevice.

REMEDY

The frequent handling of articles liable to be attacked is one of the best means of prevention, as this species prefers retreats which are seldom molested. Naphthalene scattered among books and materials containing starchy mixtures is a very good preventive. Dusting pyrethrum powder about the infested areas is said to be destructive to them. A thorough cleaning, supplemented by the liberal use of gasoline, is probably the best method of treatment in cases of severe infestation, but, fortunately, such instances rarely occur.

HOUSE CENTIPEDE OR THOUSAND-LEGGED WORM

(*Scutigera forceps* Raf.)

This is not a true insect but its frequent occurrence in houses will, I think, warrant giving it consideration in this bulletin. It belongs to a class of the Arthropoda known as Chilopoda, while all insects belong to an entirely different class, called Insecta (Hexapoda).

This creature is of a yellowish-brown color, flattened, about one inch in length, not measuring its appendages, and is made up of two main divisions—head and body; the former bearing a pair of long feelers (antennae) and the latter fifteen pairs of long delicate legs. The last pair of legs are much longer than any of the others, and at a casual glance look more like antennae than legs.

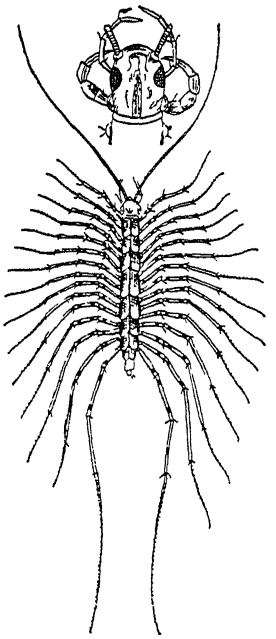

Fig. 31. House centipede.

Most housekeepers detest this rapid-moving, darting, worm-like centipede. Although disliked, this species is in reality a friend of the housewife, owing to the fact that it feeds exclusively upon small household pests, such as houseflies, croton bugs, silver fish, clothes moths, and in all probability upon bedbugs and such other small insects as it may find. The bite of the thousand-legged worm is somewhat poisonous, depending more or less upon the susceptibility of the individual, but it is doubtful if it will ever voluntarily attack man except in self defense.

REMEDY

A prompt application of ammonia to the wounded parts will often relieve the pain caused by the bite of the centipede. This species usually frequents damp and unsanitary locations, such as old bathrooms, cellars, beneath decaying pieces of board, such as form an excellent retreat, and many other similar situations might be mentioned. As stated before, they are beneficial, but when they become too abundant for comfort, it is best to destroy them. This may be accomplished by killing them when seen, and by sprinkling fresh pyrethrum powder around in their haunts.

THE BACON OR HAM BEETLE

(*Dermestes lardarius* Linn.)

This stout, blackish insect is about 5-16 of an inch long and ⅛ of an inch broad. The basal half or thereabouts of the elytra or wing-covers is clothed with grayish-yellow scales, midway of which are six black spots. These spots may be quite distinct, or more or less run together, forming two short irregular bands, one on each wing cover. It is commonly known as the larder, ham, or bacon beetle, from its habit of feeding upon stored meat products, especially bacon and ham; it is also especially fond of old cheese. Its food preferably consists of the fatty portion of the meat.

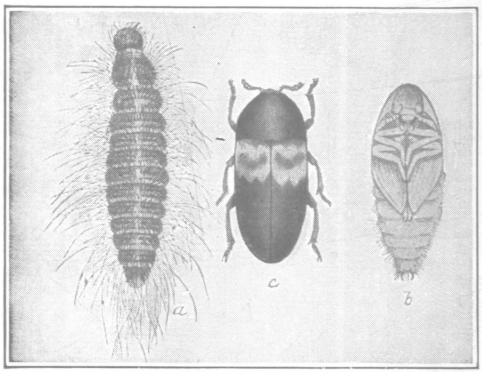

Fig. 32. Bacon beetle.

The adult beetles are to be found in the spring, and are usually most abundant during the month of June. During this period of the year, it enters houses, especially smoke-houses which contain its favorite food supply. They lay their eggs upon the food, or if this is out of reach, near a crack or small opening through which the newly hatched larvae may crawl to it. The larva or worm-like crawler, when full grown, is brown, hairy, and about 9-16 of an inch long. These hairy crawlers feed upon the surface of their food until nearly grown, when they bury themselves in it and change to pupae. This pupal stage usually lasts from four to five days or longer, depending upon the conditions. It has been stated that a single brood may mature in six weeks under favorable conditions. We may, therefore, if warmth and the food supply are favorable, get several broods per year.

METHODS OF CONTROL

Food products which are attractive to these insects should be kept in receptacles which are insect proof, if in localities where this beetle is known to be present. When food products become infested, the affected area should be cut away and the freshly cut surface washed with a dilute solution of carbolic acid. Trapping these insects with scraps of meat or old cheese will often prove quite valuable, as the beetles can be easily collected and killed. Store-houses, smoke-houses, and places which become badly infested

should be thoroughly cleaned and fumigated with carbon bisulfide or hydrocyanic acid gas. If not convenient to fumigate, one can spray the room thoroughly with benzine which will prove very satisfactory.

THE CHEESE FLY OR HAM SKIPPER

(*Piophila casei* Linn.)

This bronze-black fly is somewhat similar in appearance to the fruit flies, and measures in length less than ¼ of an inch. They are, as a general rule, more or less plentiful about meat packing-houses and cheese factories. They lay their eggs, which are only about 1-25 of an inch in length and ¼ as much in diameter, upon ham, bacon, and cheese. They are likewise particularly partial to old, soft, fatty, and strong-smelling cheese. These eggs hatch in about two days and the small, cylindrical maggot which emerges, commences feeding at once, and ordinarily becomes full grown in a little over a week, measuring, when full grown, about 3-10 of an inch.

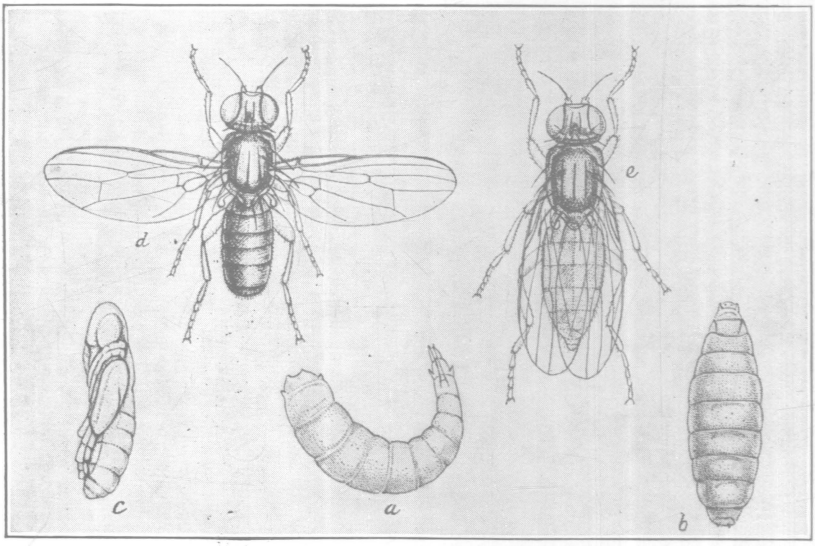

Fig. 33. Cheese fly.

This insect receives its popular name of "skipper" from its peculiar habit of bringing the anterior and posterior end of its body together, and then suddenly throwing them apart like a bent spring. By this method of procedure, it is capable of jumping or skipping several inches at each recoil. On becoming full grown, this maggot seeks some dry location where it gradually changes to a small brown pupa. In about two weeks, the adult fly emerges from the brown

pupal case. It has been estimated that the average length of time for this insect to develop from egg to adult, under favorable conditions, is from four to five weeks, thus giving us about three broods per year. The breeding season ordinarily extends from May to September.

METHODS OF CONTROL

Carefully screen all food products liable to attack, using at least 24 meshes to the inch, or keep the articles of food in some vessel that is insect proof. Keeping articles of food in dark rooms is also a good preventive, for the flies dislike to enter dark places to oviposit. Hams and cheeses, on becoming infested, are not necessarily worthless, but may become so if the infestation is for a good while undiscovered. The affected areas may be cut away and the food be placed back in the store room again, after the same has been subjected to a thorough washing with boiling water, soap suds and washing soda to get rid of all grease and dirt. Cleanliness and thorough screening of storage windows, doors, and ventilators are the best methods of preventing infestation.

YELLOW JACKETS

(*Vespa germanica* Fab.)

These yellow and black wasps that build their paper nests in underground cavities are familiar, at least to the country people. They frequently enter houses when the nests are close by. Sweets of various kinds are very attractive to them, and it is not an uncommon sight to see them in great numbers on ripe and decaying fruits. They are active enemies of the housefly, but since they are irritable and sting when interfered with they are not usually considered very beneficial.

METHODS OF CONTROL

When these insects become too plentiful for comfort, find their nests, and after dark pour a little carbon bisulfide or chloroform into the entrance, thus killing all the inmates. After dark is the time that should be selected for killing them, for it is a well known fact that all of the wasps return to their nests at night, and do not leave again until morning. Of course the screening of doors and windows will keep these insects out of the houses.

BALD-FACED HORNETS

(*Vespa maculata* Linn.)

These insects are somewhat larger than the former species, being black and white in color, and build their gray-colored paper nests in trees and bushes. They frequently enter houses in small numbers to feed on flies and sweets. They can be controlled in the same manner as the preceding species.

THE POWDER-POST BEETLE

(Lyctus sp.)

Several species of the above beetles have been reported from time to time as destroying seasoned hardwood products, such as floors, picture frames, mantels, and numerous other wooden articles belonging to the house. They work by preference in unpainted or unvarnished material, but have been known to attack articles after treatment. Fine sawdust on the floor near some article of furniture, having small, shot-like exit holes in it, is a fairly good indication that this insect is at work. Often the articles will be found to be completely ruined, nothing being left but a mere shell of frame-work which can be easily crushed.

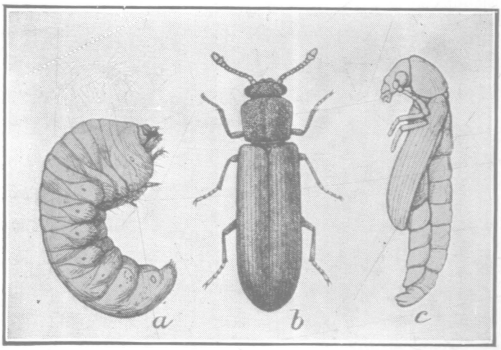

Fig. 34. Powder-post beetle.

The adult beetles of the above genus vary in color from brown to black, the majority of them being about 3-16 of an inch long. Each female lays numerous eggs in the spring in some seasoned piece of wood, and the young grubs proceed to feed in all directions through the wood, until nearly mature, when they construct small cells at the ends of their burrows where they change to pupae and later emerge from these cells as adult beetles.

Under ordinary conditions, there is probably but one brood per year. The infestation often takes place in the mill before the wood is worked up for final use; such being the case, they will continue their work and later emerge from the finished articles of furniture.

These species seem to prefer the sap-wood to the heart-wood. The winter is usually spent in the wood, the adults emerging in the spring to start a new generation.

METHODS OF CONTROL

Infested articles should be treated with turpentine, benzine, gasoline or carbon bisulfide. This is accomplished by pouring sufficient quantities of the above liquids into the exit holes of the beetles to reach the entire length of their burrows. This will kill all life within the wood, but the inflammability of the above materials should be borne in mind when giving the treatment, especially if the last named one is used.

TERMITES

(*Termes flavipes* Koll.)

Termites or white ants as they are often called, are not true ants but belong to an entirely different order of insects. It is true they live in social groups as do the true ants, but their development and structure are much different, and the food consists mostly of decaying wood or vegetable matter. There are four forms of the above species. The workers, by far the most abundant individuals of the colony, are white, blind, wingless, sexually undeveloped males and females.

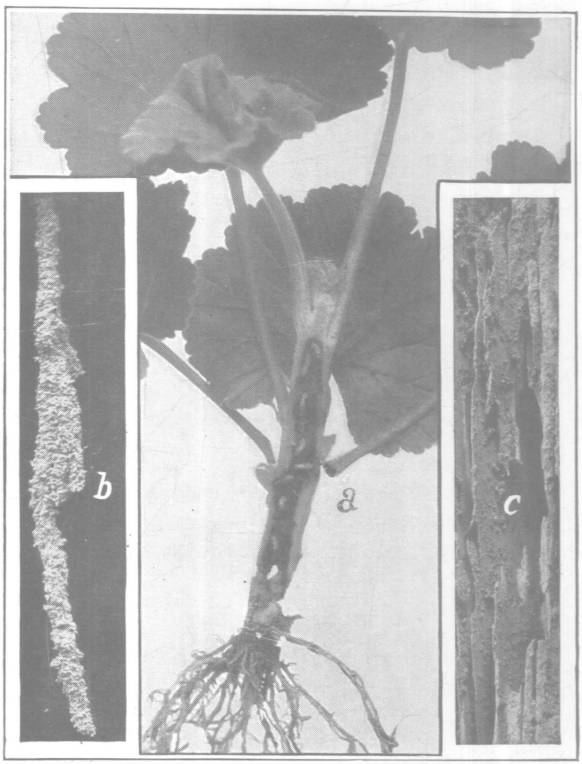

Fig. 35. Termites and their work.

The soldiers occur in small numbers, have much larger heads and mandibles, and are likewise sexually undeveloped, white, blind, and wingless males and females. They are supposed to do the fighting for the society.

The winged males and females are produced each spring, but owing to their delicate wings are poor flyers. The insects emerge in great numbers, forming holes in a stump or other infested

material. One will find on digging away the wood at the exit point, that the underlying wood is tunneled out and inhabited by many of the white, ant-like insects about one-third of an inch long. These are the workers and soldiers previously mentioned. The winged males and females are blackish in color, resembling somewhat the winged forms of true ants, but these termites may be easily distinguished from the same by the presence of cross veins in the wings. After their nuptial flight, which occurs soon after issuing from the wood, a pair will find some suitable place to start a new colony. They strip off their wings, leaving but mere stumps, and then the female lays eggs which give rise to a new colony. One brood of perfectly sexed males and females occurs each spring. The above method of forming new colonies is undoubtedly very slow, owing to the fact that these insects are poor flyers. They make but a short nuptial flight, generally alighting a short distance from the starting point, unless favored by a strong wind. New colonies are not formed unless the migrants happen to come across favorable locations, because they have many insectivorous foes; then, too, they are slow on foot and are unable to cope with their enemies. When portions of infested material are carried into new localities, a new colony is formed. This is probably the most frequent method of forming a new colony. These insects, although more common in the southern states, occasionally do damage here. I recall two instances occurring during the past year; one the undermining of a portion of the woodwork of the benches in the Botanical greenhouse of the Ohio State University, the other occurring in a greenhouse in Wooster. In the latter case these insects mined hundreds of geranium plants, tunneling in their stems. This species is often found in old stumps in the woods.

METHODS OF CONTROL

When a building becomes infested nothing can be done, except to tear out the infested parts, because this species works entirely concealed. Fumigating with hydrocyanic acid gas or carbon bisulfide is advisable when one can get at the seat of the trouble, that is, where the fumes will reach all the insects. In some instances, it would be advisable to replace wood with some other material such as iron, stone, cement or bricks. The great trouble is to find the source of infestation, owing to the fact that they avoid the light when emerging from their tunnels. Gasoline is a good remedy if it is possible to fill the entire burrow. Wood soaked in creosote is also said to be proof against these insects. One would have to judge from a personal inspection what method to use in each case. It has been stated by Prof. H. A. Ballou that a mixture of arsenic or strychnine with

sugar can be put down in these galleries as a poison bait. The insects which are killed by this, are eaten by their kindred in the nest and the poison becomes widely distributed.

CRICKETS

(*Gryllus sp.*)

These insects are quite common and, at times, have been recorded as having entered houses where they did considerable damage by cutting into clothing, especially fabrics which were a little damp. Instances are on record where they ruined clothing in one night. They vary in color from brownish to black, depending upon the species. The head bears two long, thread-like feelers (antennae), the hind legs are strongly developed for jumping, and the egg-laying tube (ovipositor) is as long or longer than the abdomen. All people who live in the country and a great many who live in the city, have, no doubt, at some time heard the familiar call of these insects.

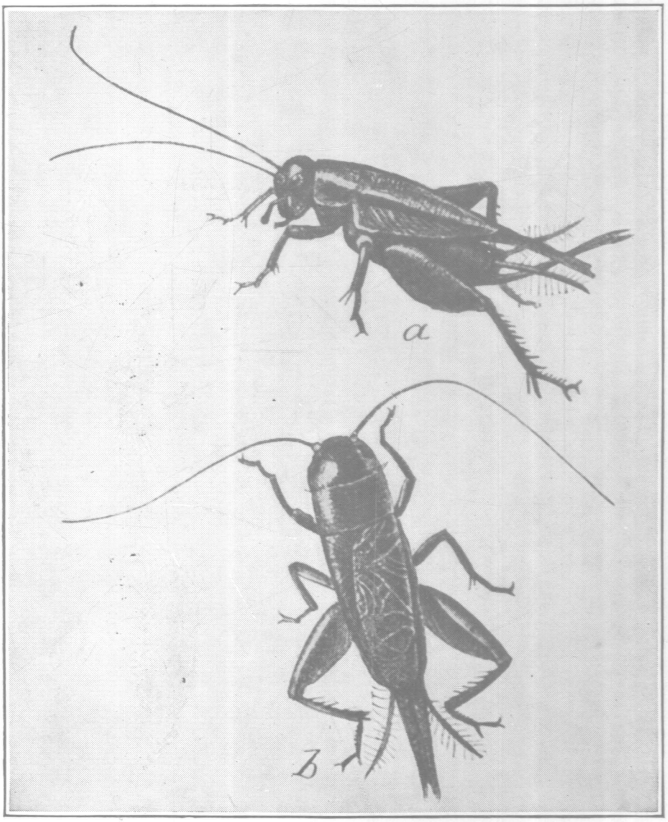

Fig. 36. Field cricket.

The chirping, or stridulating as it is sometimes called, is made by the male alone for the purpose of attracting the female. The musical note of the male cricket is produced by elevating the outer wings or tegminae, and then scraping them together, one over the other, thus producing a vibration.

This insect has been known to remain active throughout the winter in well-heated houses, but ordinarily it remains in a dormant state until the approach of warm weather.

METHODS OF CONTROL

Crickets are very fond of green-cut vegetables and sweetened liquids, so we can at once suggest a means of extermination. One of the most simple and effective applications of this suggestion consists in cutting up a few uncooked potatoes, sprinkling the same with a little arsenic, and then placing the poisoned bait in their haunts. This method will undoubtedly kill many, but one must be careful when using this poison, that nothing else gets the bait.

CLOVER MITES

(*Bryobia pratensis* Garm.)

This is not a pest of the house but of out-doors, as indicated by its popular name. During the fall of the year, it sometimes migrates to houses from surrounding vegetation, and, as a consequence, arouses the fears of the careful housewife unless she has had experience with it before. Masses of the small red eggs of this mite are frequently found in the crotches of small limbs of the apple and other trees. It apparently migrates to the house for shelter only, as it certainly does no harm there. When occurring in great numbers, their presence, if not detrimental, is rather disagreeable and means of extermination should be adopted.

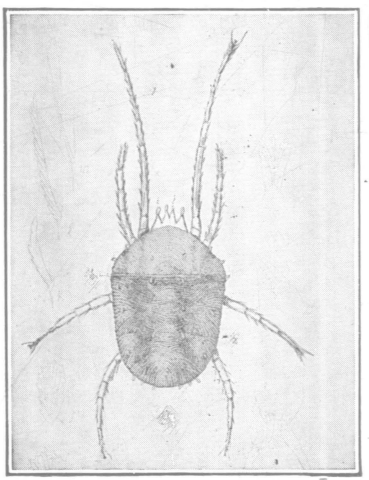

Fig. 37. Clover mite

METHODS OF CONTROL

Burning of pyrethrum is a simple and effective remedy. Spraying with benzine or gasoline will kill all that are reached by the spray. Fumigating with hydrocyanic acid gas will kill all life in the house, but it is seldom worth while to go to this trouble and expense.

"KISSING BUG" OR BEDBUG HUNTER

(*Reduvius personatus* Linn.)

This is one of a group of bugs, comprising several species, which was given such wide notoriety through the newspapers in 1899, causing considerable alarm through the U. S. It is an European introduction, but the date of its first appearance in this country is not known. This entire group of ("Kissing Bugs") insects are predaceous (that is, feed upon other insects) and in Europe they haunt houses for the purpose of feeding upon bedbugs. The mature, winged, black or blackish insect is about 11-16 of an inch long and, in appearance, reminds one of the common squash bug. The bodies of the young insects are covered with a sticky substance to which lint and dirt readily adhere. This enables them to creep up to their victim without being detected. Bites inflicted by this insect and by its allied forms are quite poisonous, especially to some people; but it is doubtful if this insect ever attacks man except when provoked, captured, or disturbed in some manner, when it naturally wounds in self defense.

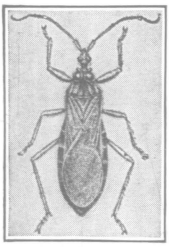

Fig. 38. "Kissing bug" or masked bedbug.

PUNKIES OR "NO-SEE-UMS"

(*Ceratopogon sp.*)

These black, delicate, two-winged flies are very nearly invisible to the naked eye. No one ever believes that such a small, insignificant little fly can inflict so much pain unless he has had experience with the insect. In fact, the bites of these blood-thirsty little midgets are so severe that they almost invariably call forth about as strong execrative language as the victim is ever in the habit of using. People out camping, or living in or near woods or beside streams or marshy areas, are often annoyed by these punkies. They are usually most plentiful during the early part of the evening and just before sunrise in the morning. I have been told by a friend who has had considerable experience with them, that they are especially fond of piercing about the ankles and between the toes. The larvae have been reported to live under fallen leaves, in decaying vegetation, in sap of trees, and in similar locations.

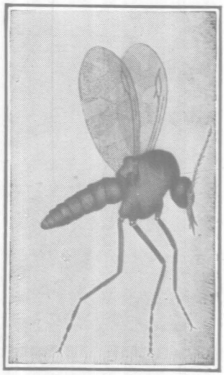

Fig. 39. Punky.

METHODS OF CONTROL

On account of their size, little can be done by means of screening to prevent these insects from entering. Burning pyrethrum indoors will undoubtedly do much to suppress the activities of the minute tormentors.

INSECTS FEEDING IN STORED PROVISIONS

The following groups of pests, although not strictly of the household, are apt to be introduced with groceries and foodstuffs, and it is, therefore, proper to include them in a treatise on household insects. My experiments confirm the conclusions of other writers that the simplest and by far the most efficient means of exterminating these pests is by heat. Spread the infested products out in pans or other open vessels so as to give a free circulation of air, thus allowing the temperature to affect all portions quickly and evenly. Then place in an oven or other convenient heating apparatus and have the temperature register 135 degrees F., and let remain for 15 minutes; this will kill all stages of the Flour beetle, (*Tribolium sp.*) and of the Flat grain beetle (*Laemophloeus minutus* Oliv.). While the lower temperature of 130 degrees to 131 degrees F. for one-half hour did not kill all of the insects, it destroyed a great many. I believe the above insects to be fair samples of the group and, as a result of the above experiments, recommend that 135 degrees F. be used for the entire group as it will not in the least hurt the quality of the foodstuffs for future use. One will find, in practice, that it is not always easy to keep an oven at an even temperature for any length of time, but the endeavor should be to keep it as near 135 degrees F. as possible. Higher temperatures than this are apt to injure the qualities of certain articles, like cereals, especially if they are allowed to stand some time after treatment before using. Carbon bisulfide and hydrocyanic acid gas have been recommended for destroying these pests, but I hardly believe they are practicable for household purposes. My objections to using these remedies are because of the expense and labor involved, and also because some danger is connected with their use, especially if the operator has never used them; while the use of heat, under most conditions, is an easy, satisfactory, and safe remedy.

Lastly, the above fumigants are not always effective in killing all forms of life when used at any ordinary strength. This is especially true in the case of the bean and pea weevil larvae and pupae, which occur inside the seeds.

There are some nineteen species of beetles, and five—or possibly more—species of moths which are apt to be introduced into houses in cereals and other cupboard supplies. I will merely give brief descriptions of a few of these pests, allowing them to represent the group as a whole.

FLAT GRAIN BEETLES

(*Laemophloeus minutus* Oliv.)

This beetle is not so important, economically, as many of the other species found in household supplies, but I mention it, principally because it is one of the smallest beetles met with in stored products. This flattened, oblong, reddish-brown beetle is about 1-16 of an inch long, and its elongated antennae or feelers are somewhat longer than ½ the length of the body. I have found these insects occurring in great numbers in Indian corn meal, and they have been reported as occurring in a variety of substances. It is probably both predaceous and a scavenger.

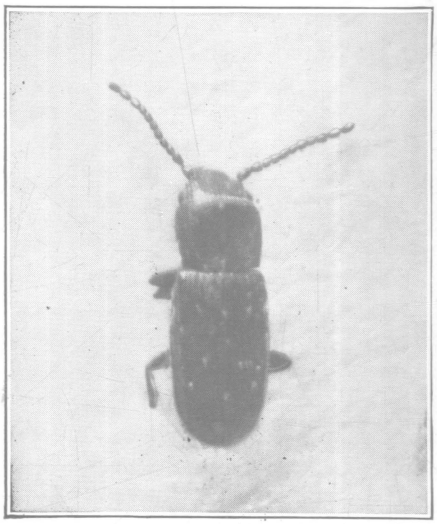

Fig. 40. Flat grain beetle.

SAW-TOOTHED GRAIN BEETLE

(*Sylvanus surinamensis* Linn.)

The above insect belongs to the same family as the preceding species and is undoubtedly one of the most common pests affecting stored products. It frequently occurs in materials infested with the Indian meal moth, and has the bad habit of eating holes through bags containing cereals and other products. It has been reported as occurring in a variety of substances, such as yeast-cakes, nuts, and even red peppers, but it is especially bad in cereals and dried fruits. This dark brown beetle is about one-eighth of an inch in length, is proportionately narrower than the preceding, and is easily recognized from its thorax being armed with six prominent teeth on either side. The

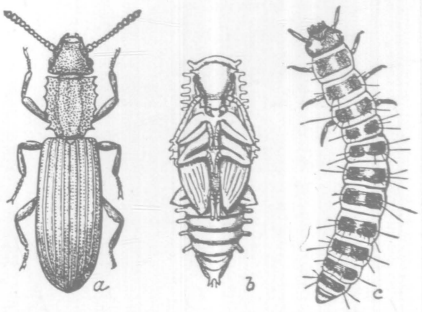

Fig. 41. Saw-toothed grain beetle.

winter is passed in the adult state and the young, which are exceedingly active and of a creamy color with rather dark bands on each segment, develop quite rapidly. When fully grown, the larvae construct small cases composed of refuse material, and change within the cases to pupae and later to adults. There are, in all probability, three or four generations each year.

CONFUSED FLOUR BEETLE

(*Tribolium confusum* Duv.)

These insects are frequently associated with the preceding species. They are general feeders, and probably the most injurious insects to flour and Indian corn meal with which the housekeeper has to contend. This elongated beetle is about 1-6 of an inch long, slightly rounded above, and of a shining, brownish-red color. Ordinarily, three or four broods occur each year. The minute, white larvae commence feeding soon after emerging from the eggs, and, when full grown, change to pupae and then to adults. The length of time which it takes to develop from the egg to the adult will depend upon the temperature and the food supply.

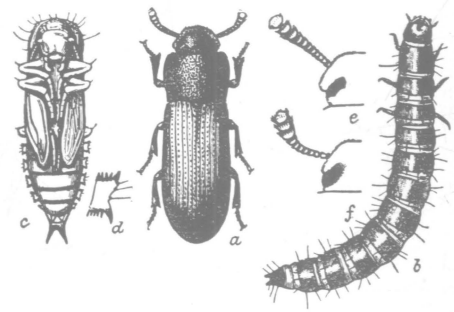

Fig. 42. Confused flour beetle.

YELLOW MEAL WORM

(*Tenebrio molitor* Linn.)

The larva of *Tenebrio molitor* is found in milled cereals, and it is especially fond of meal which is a little damp and musty. This chocolate, brownish-black beetle is about 3-5 of an inch long and ⅓ as broad; this is our largest cereal pest. It belongs to the same family as *Tribolium confusum* which it resembles in many ways, except as to its larger size. The adults lay most of their eggs during the months of May or June. These insects are night fliers and are frequently caught around lights. There is but one brood each year. The grub of this insect is cylindrical, and looks a great deal like a wire-worm. It is yellowish in color, with darker shading at either end, and is seven or eight times

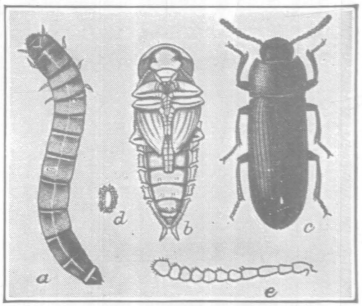

Fig. 43. Yellow meal worm.

as long as broad. The grubs pass the winter in the larval state, and when the warm days of spring come, change to pupae and about two weeks later emerge as adult beetles.

INDIAN-MEAL MOTH

(*Plodia interpunctella* Hbn.)

This moth is of frequent occurrence in houses and resembles the clothes moth to a great extent, both in size and flight. In fact, it is often mistaken for it. It is one of the most common pests of the cupboard, and is a general feeder; showing preference, however, for cereal products, seeds and dry fruit. The moth has about one-half inch wing-expanse, grayish-yellow hind wings, and the bases of the fore wings are yellowish, while the outer portions are of a somewhat coppery-brown color. This insect not only does damage by feeding on the materials it infests, but it damages the food in general by constructing a web as it works, which is composed of excrement and particles of dirt. There are, under ordinary conditions, 2 broods each year in northern Ohio, but with increased temperature one may have 4 or 5 or more per year. When the caterpillar becomes full grown, it forms a small cocoon of silk and dirt particles, and changes to a pupa; later emerging as the adult moth.

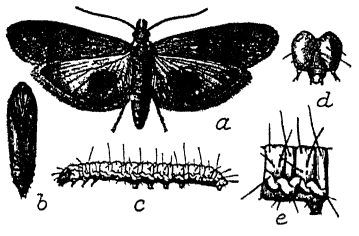

Fig. 44. Indian meal moth.

FLOUR, SUGAR, CHEESE, AND HAM MITES.

(*Tyroglyphus sp.*)

These minute, soft-bodied, light-colored mites are about twice as long as broad. Each leg terminates in a single claw and the back and legs bear several long, bristle-like hairs, the most prominent of which are used as characters for determining the different species. Rapidity of breeding makes up for their small size. It is not uncommon to find infested products fairly alive with these minute pests. Grocers and other persons handling infested products often get them on their hands, the mites causing a disagreeable irritation commonly called the "grocers itch." The adults lay their eggs at random upon some article of food; these hatch into minute, six-legged nymphs; feed a short time; molt and emerging this time with eight legs, they feed a while longer, then become full grown and lay eggs for the next generation. Under certain conditions, instead of developing according to the above program, other changes take place; the nymph then forms a hard, chitinous covering

of a brownish color; its legs become much shortened and unadapted for walking. When in this latter state, it is known as a *Hypopus*, and this may be appropriately called the migratory stage, for it is while in this condition that it is frequently carried to new food products by means of several ventrally located disk-like suckers, which enable it to attach itself to passing insects or to any other form of life which may pass its way. On reaching the new food material, it settles down and molts, transforming to a soft-bodied creature as before; feeds for a short time; becomes an adult; and in time lays eggs. These pests are, as a rule, most abundant during warm weather, although they will undoubtedly breed throughout the year in well heated rooms.

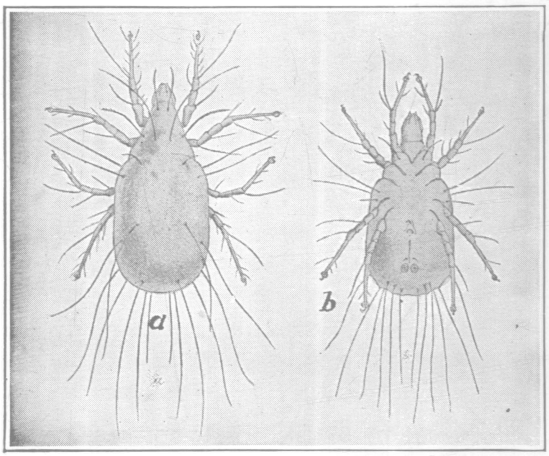

Fig. 45. *Tyroglyphus longior*

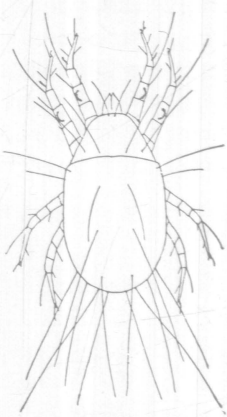

Fig. 46. *Tyroglyphus americanus.*

METHOD OF CONTROL

It is entirely impracticable and almost useless, to expect to kill these pests by fumigation as they are apparently without spiracles or any definite breathing pores. Screening of doors and windows with fine mesh to keep out insects, which are at least the principal carriers of infestation, will do much to prevent new out breaks. Dr. L. O. Howard writes me that frequent shifting of food products will have some good effect. I find that these mites may be killed by spreading the infested material out in a thin layer and exposing the same to a temperature of 135 degrees F. for ten minutes.

FUMIGATION DIRECTIONS

HYDROCYANIC ACID GAS

Caution: It must be remembered at the outset that potassium cyanide is one of the most deadly of poisons both when taken internally in its crystaline state, and when inhaled in its gaseous condition, consequently, one should use extreme care in the handling of this substance.

First, find the number of cubic feet in the room to be fumigated.

Second, make the room as tight as possible by stopping up all cracks and crevices.

Third, moisture takes up a small amount of acid and as a consequence one should remove all meats, butter and similar articles of food. On the other hand dry food products are not affected by this gas.

Fourth, weigh out in separate receptacles the desired amount of potassium cyanide (98 percent pure) and of commercial sulfuric acid which usually runs about 85 percent pure, and of water, using these ingredients in the following proportions: One ounce of potassium cyanide, two fluid ounces of sulphuric acid, and four fluid ounces of water to each one hundred cubic feet of space.

Fifth, use an earthenware dish or jar to generate the gas, preferably one deep enough to prevent the bubbling liquid from spattering over the edges. If a half-pound of cyanide is used for each charge, the jar used should not hold less than two gallons. For perfect safety, to prevent injury to floors, carpets, etc., it is best to set the generator in a second dish. It is not best, under ordinary circumstances, to use over one pound of cyanide to a generator.

Sixth, pour the required amount of water into the generator, then slowly add the acid. Now you are ready to add the cyanide, which previously should have been broken into small lumps and placed in thin paper bags. The reason for placing it in the bags is to slightly delay the action of the acid, thus giving the operator more time to leave the room before the fumes are given off. Leave the room immediately after dropping the bag containing the cyanide into the generator and close the door securely. The room should be fumigated for at least an hour or so, preferably for several hours, and at the end of that time it may be opened up from the outside only. Under no circumstances should a person enter the room before one-half hour after opening. If several jars are required in fumigating a large room, the operator should commence dropping the cyanide in from the far end of the room and work towards the exit. Likewise, in fumigating an entire house, always begin operations in the upper rooms and work towards the first floor.

Seventh, the jars should be taken out, after thoroughly airing the room, and the contents either thrown down the sewer or buried in the ground where the refuse can do no damage.

SULPHUR FUMES OR SULPHUR DIOXIDE

Sulfur fumes differ from hydrocyanic acid gas in that they tarnish metals and bleach certain colors of fabrics and wall paper. This gas can be used to best advantage in houses which do not have such furnishings. For satisfactory results make the room as tight as possible by stopping up all openings, and use at the rate of one quarter of a pound to each one hundred cubic feet of space. Sulphur candles, which can be bought in various sizes, furnish a convenient means of fumigation. When all things in the room, such as drawers, closets, etc., have been opened so that the fumes can penetrate readily to all corners, place the candles on some stationary object in a basin or tub of water. The operator should leave the room immediately after lighting the candles. Keep the room closed for four or five hours.

CARBON BISULFIDE

The fumes of this chemical, unlike the hydrocyanic acid gas, are heavier than air, and as a consequence, the liquid should be placed high up near to the ceiling, preferably in a shallow vessel. This substance is extremely inflammable and should, under no circumstances, be used in the presence of fire, such as a lighted cigar, pipe or lamp. Carbon bisulfide will prove a satisfactory remedy, under favorable conditions, when used at the rate of one-half pound to one hundred cubic feet of space. It is not thought advisable to recommend it as a general household remedy, owing to its extreme inflammability and poisonous nature. It should be handled with care at all times.

Generally speaking, these gases cannot be depended on to kill the eggs of insects. Consequently, it is necessary to make a second treatment about two weeks after the first in cases where both adult insects and their eggs occur at the same time.

ACKNOWLEDGMENTS

I wish to express my thanks to Prof. H. A. Gossard, for his suggestions and criticisms during the preparation of this manuscript. Mr. Wm. P. Beeching, Jr., Station Photographer, has reproduced or prepared all of the illustrations for this publication. Thanks are due Messrs. Beeching, Goodwin, and King for certain original photographs which appear in this bulletin. Full credit is given to each contributor furnishing the illustrations which appear in the foregoing pages, under the heading, "List of Illustrations." Under the same heading will also be found an index to the lettering of the various figures.

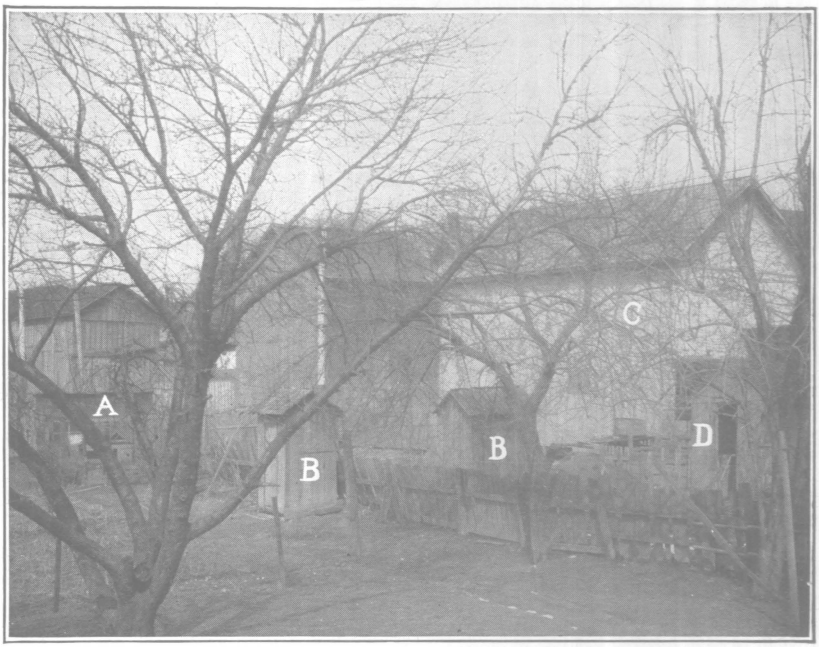

Plate I. Favorable locality for incubation of house flies and typhoid germs. View from back porch. A, hen house; B, privy; C, stable; D, hog pen.

LIST OF ILLUSTRATIONS

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